

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

ALTURAS GROUND WATER BASIN WATER QUALITY STUDY



JANUARY 1986

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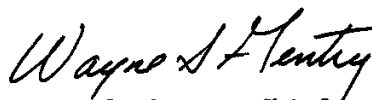
FOREWORD

The principal objective of the investigation leading to this report was to update knowledge of water quality of the Alturas Ground Water Basin in the south-central Modoc County. The basin encompasses an area of about 135 square miles, and contains approximately 7.5 million acre-feet of ground water in storage to a depth of 800 feet.

The basin's quality has been monitored annually since 1959, providing information which was particularly helpful in the planning of this study. Wells have been monitored on a yearly basis to determine natural variation and detect long-term trends.

The additional information developed is essential not only in managing this water resource to maximize its beneficial uses, but also to plan for future conjunctive ground and surface water uses. It should also be useful to help develop more definitive objectives for water quality control plans.

This report includes a brief overview of the study area, its geology, climate, development, and water supply. It describes the hydrologic conditions that prevail, summarizes water quality data, and sets forth findings and conclusions.


Wayne S. Gentry, Chief
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CONVERSION FACTORS

Quantity	To Convert from Metric Unit	To Customary Unit	Multiply Metric Unit By	To Convert to Metric Unit Multiply Customary Unit By
Length	millimetres (mm)	inches (in)	0.03937	25.4
	centimetres (cm) for snow depth	inches (in)	0.3937	2.54
	metres (m)	feet (ft)	3.2808	0.3048
	kilometres (km)	miles (mi)	0.62139	1.6093
Area	square millimetres (mm ²)	square inches (in ²)	0.00155	645.16
	square metres (m ²)	square feet (ft ²)	10.764	0.092903
	hectares (ha)	acres (ac)	2.4710	0.40469
	square kilometres (km ²)	square miles (mi ²)	0.3861	2.590
Volume	litres (L)	gallons (gal)	0.26417	3.7854
	megalitres	million gallons (10 ⁶ gal)	0.26417	3.7854
	cubic metres (m ³)	cubic feet (ft ³)	35.315	0.028317
	cubic metres (m ³)	cubic yards (yd ³)	1.308	0.76455
	cubic dekametres (dam ³)	acre-feet (ac-ft)	0.8107	1.2335
Flow	cubic metres per second (m ³ /s)	cubic feet per second (ft ³ /s)	35.315	0.028317
	litres per minute (L/min)	gallons per minute (gal/min)	0.26417	3.7854
	litres per day (L/day)	gallons per day (gal/day)	0.26417	3.7854
	megalitres per day (ML/day)	million gallons per day (mgd)	0.26417	3.7854
	cubic dekametres per day (dam ³ /day)	acre-feet per day (ac-ft/day)	0.8107	1.2335
Mass	kilograms (kg)	pounds (lb)	2.2046	0.45359
	megagrams (Mg)	tons (short, 2,000 lb)	1.1023	0.90718
Velocity	metres per second (m/s)	feet per second (ft/s)	3.2808	0.3048
Power	kilowatts (kW)	horsepower (hp)	1.3405	0.746
Pressure	kilopascals (kPa)	pounds per square inch (psi)	0.14505	6.8948
	kilopascals (kPa)	feet head of water	0.33456	2.989
Specific Capacity	litres per minute per metre drawdown	gallons per minute per foot drawdown	0.08052	12.419
Concentration	milligrams per litre (mg/L)	parts per million (ppm)	1.0	1.0
Electrical Conductivity	microsiemens per centimetre (µS/cm)	micromhos per centimetre	1.0	1.0
Temperature	degrees Celsius (°C)	degrees Fahrenheit (°F)	(1.8 × °C) + 32	(°F - 32)/1.8

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INTRODUCTION

The Department of Water Resources conducted an extensive investigation of the ground water basins of northeastern California in the late 1950s. Results were reported in Bulletin 98, "Northeast Counties Ground Water Investigation", February 1963. In conjunction with that investigation, water quality studies were made which provided a good overview of ground waters in the Alturas Basin.

Since then, there has been a large increase in the use of ground water in northeastern California and growing concern over the resultant decline of water levels in wells. The concern for these valuable ground water resources led to a reevaluation of the hydrologic conditions in the northeast counties basins, including Alturas Basin, with results being published in the Northern District report "Northeastern Counties Ground Water Update", 1982.

This water quality study of Alturas Basin was undertaken to provide current information and supplement the hydrologic update. Its objectives were to:

1. Determine the present quality of Alturas Basin ground waters.
2. Evaluate the water quality as it relates to beneficial uses.
3. Detect and evaluate existing water quality problems.

Scope

In the initial phase of the study, historic data were compiled and evaluated. Well logs were reviewed and wells were selected for supplemental sampling to improve areal coverage and better define areas with poor quality water. During the summer of 1982 and spring of 1983, wells were located and samples collected for analysis. At the time of field collection, temperature, pH, and electrical conductivity (EC) measurements were made. Selected samples were then delivered to the Department's chemical laboratory in Bryce for more detailed analysis.

Analyses received from the laboratory were checked and put into the Department's Water Data Information System. Results were used to evaluate the present ground water quality and relate this to the historic quality. Water quality problems were identified by comparing the quality with criteria related to major beneficial uses. Data developed from the Department's ground water quality monitoring program provided information on the change of quality with time.

This report includes a description of the methods used in the investigation, an evaluation of the present ground water quality, a description of water quality problem areas, and information on water quality changes. Findings, conclusions, and recommendations are included. All data developed during this investigation along with historic data are included in the appendices.

Area of Investigation

Alturas Basin is located in the south-central portion of Modoc County, in Northeastern California (Plate 1). The basin is east of the Cascade Mountain Range and on the western side of the Warner Range. It includes two elongated areas or subbasins which meet in the vicinity of Alturas. The eastern subbasin is about 25 miles long in a north-south direction and ranges up to 6 miles in width. This subbasin includes a valley floor area of about 100 square miles. The valley slopes from south to north and drops in elevation from about 4,500 feet to 4,370 feet. The western subbasin, formerly known as the Warm Springs Basin, has an east-west length of 15 miles and is about 8 miles across at its widest point. It has an area of about 34 square miles, and its elevation is about 4,350 feet. It drains from northeast to southwest. The ground water basin, with a total valley floor area of about 134 square miles, has a contributing watershed area of about 1,430 square miles.

Geology

Alturas Basin is located in an area of volcanic and sedimentary rocks of the Modoc Plateau. It is rimmed by highly jointed lava flows of Plio-Pleistocene age. The basin is underlain by poorly permeable, volcanic rocks of Miocene age. The main water-bearing formation in the basin is the Plio-Pleistocene Alturas Formation, mostly comprised of lake-deposited tuff, ash, sandstone, gravel, and diatomite. Its thickness ranges up to 1,450 feet. The formation also includes a basalt member, ranging from 50 to 250 feet thick, and the Warm Springs tuff member, 100 to 400 feet thick. Recent valley sedimentary deposits of clay, silt, and fine sand, 0 to 50 feet thick (see Figure 1), overlie the Alturas Formation.

Climate

The Alturas Basin's climate can be classified as semi-arid. It has cold, wet winters and warm, dry summers. The major factors affecting the climate of northeastern California are being over 150 miles inland and the orographic rainfall pattern of California.

Moisture-laden air moves into California in an easterly direction. As the air rises over and crosses the Coast Ranges, it loses much of its moisture. Moisture is further removed from the air masses as they continue eastward across the Cascade Ranges and finally the Warner Mountain Range. It is this last bit of precipitation over the windward (western) face of the Warners that supplies the Alturas Basin with water, via runoff and snowmelt from streams draining out of the Warners into the Alturas Basin.

Approximately 70 percent of the total precipitation that the Alturas Basin receives occurs between October and March. Much of this is in the form of snow. Heaviest precipitation occurs in December, with a mean monthly accumulation of 1.6 inches. The driest month is July, with a mean monthly accumulation of 0.3 inches. Mean annual Alturas Basin precipitation is about 13.4 inches.

Alturas basin generally has cold winters and warm summers. The coldest mean monthly temperature for the Alturas area is 28.6 degrees F, occurring in January. The average daily maximum temperature in January is about 40 degrees F. The warmest mean monthly temperature occurs in July;

Figure 1

GEOLOGIC FORMATIONS IN ALTURAS BASIN					
GEOLOGIC AGE	GEOLOGIC FORMATION	STRATIGRAPHY	APPROXIMATE THICKNESS IN FEET	PHYSICAL CHARACTERISTICS	WATER-BEARING CHARACTERISTICS
CENOZOIC	QUATERNARY	RECENT	TALUS	Qta: Unconsolidated blocks of rock. Of small areal extent.	Highly permeable, but usually above zone of saturation. Yields water to springs.
			MUCK AND PEAT	Qmp: Unconsolidated deposits of organic muck and fibrous peat. Found only in Jess Valley.	Very low permeability. Unimportant as source of ground water.
			BASIN DEPOSITS	Qb: Unconsolidated, interstratified clay, silt, and fine sand.	Permeability moderate to slight. May yield small supplies of water to wells.
			INTERMEDIATE ALLUVIUM	Qai: Unconsolidated, poorly sorted silt and sand with some lenses of gravel.	Moderately permeable. Yields moderate quantities of water to shallow wells.
			ALLUVIAL FANS	Qis: Unconsolidated to poorly consolidated, rudely stratified sand, silt, and gravel, with lenses of clay.	High permeability. May yield large quantities of water to wells; may contain confined water.
			LANDSLIDE	Qls: Unconsolidated mixture of blocks of basalt in matrix of clay and sand.	Of low permeability and of little importance to ground water.
		PLEISTOCENE	PLEISTOCENE BASALT	Qpvb: Highly jointed, flat-lying olivine basalt flows with interbedded scoriaceous zones.	Unit as a whole moderately permeable. Acts as forebay for recharge to adjacent sediments.
			PYROCLASTIC ROCKS	Qpvp: Semiconsolidated red and black cinders.	Moderately permeable but contains little water due to being above saturated zone.
			NEAR-SHORE DEPOSITS	Qps: Slightly consolidated and cemented, poorly to well stratified pebbles and cobble gravel with lenses of sand and silt.	Of moderate permeability. May yield fair to moderate quantities of water to wells.
			UPPER MEMBER, ALTURAS FORMATION	TQa: Lake deposited tuff, ashy sandstone, gravel, and diatomite. Indistinguishable from lower member.	Moderate to high permeability. Yields large quantities of water to wells. Contains confined water.
			PLIO-PLEISTOCENE BASALT MEMBER	TQvb: Jointed, nearly flat-lying flows of basalt with zones of scoria.	Unit as a whole is moderately permeable. Yields water to numerous springs. Acts as forebay for recharge to adjacent sediments. May yield moderate amounts of water to wells.
	TERTIARY	PLIO-PLEISTOCENE	WARM SPRINGS TUFF MEMBER	TQvt: Massive pumice lapilli tuff, jointed beds of welded tuff, minor beds of ashy sandstone.	Transmits small quantities of water along joints and fractures. Sandstone beds may yield moderate quantities of water.
			LOWER MEMBER, ALTURAS FORMATION	TQa: Indistinguishable from upper member. May be Miocene in part.	Same as upper member.
			ANDESITE	Tpva: Plugs of massive and platy andesite.	Essentially impermeable.
			BASALT	Tpva: Jointed, dipping flows of basalt.	Fair to poor overall permeability. Locally yields small amounts of water to springs.
			RHYOLITE	Trr: Massive, light-colored plugs of rhyolite.	Essentially impermeable.
		MIOCENE	BASALT	Tmbv: Flows of jointed vesicular basalt.	Transmits only minor quantities of water along joints.
			PYROCLASTIC ROCKS	Tmvp: Bedded mudflows, tuffs, ashy sandstone, and diatomite. May be correlative to Turner Creek formation. Upper portion may grade into lower member of Alturas formation.	Of low overall permeability. A few permeable beds may yield limited quantities of ground water to wells.
			TURNER CREEK FORMATION	Tmtc: Massive mudflows and tuffs with beds of ashy sandstone and diatomite. Upper portion may be correlative to lower member of Alturas formation.	Of low overall permeability. A few permeable beds may yield limited quantities of ground water to wells.
			JEDARVILLE SERIES	Tmc: Massive tuff breccia, basalt, and andesite.	Nearly impermeable. May yield small amounts of water from fractures and joints.

it is 66.2 degrees F. July's average daily maximum is 88.2 degrees F, and its average daily minimum is about 44 degrees F.

Development

Though a few brave pioneers settled in the area as early as 1846, the fierce Modoc Indians discouraged most settlement until after the close of the Modoc Indian Wars, in 1873. The grasslands along the Pit River, including the Alturas Basin, were especially attractive for cattle raising. Most development took place where water could be diverted from the Pit River or tributary streams and used to expand the natural pastures to increase production.

Secondary activity in the basin includes wood processing in Alturas. It is also a tourist stop, as U. S. Highways 299 and 395 intersect there. The Southern Pacific Railroad serves the area's lumber mills. However, livestock are more frequently sent to market by truck than by rail.

A population of 3,000 is supported in the Alturas area, which is the service and supply center for most of the basin's population. Two other small communities are situated in Alturas Basin; Canby in the western end, and Likely in the southern end of the basin.

Water Supply

Most of the water supply for the Alturas Basin originates as snowmelt and most of the runoff occurs from March through July, while water demands are greatest from May through September. Water shortages occurring in July, August, and September posed problems for early settlers, and numerous reservoirs were built to provide water in the summer and fall. These include West Valley, Pine Creek, Payne, French, Dorris, and Dannhauser Reservoirs, to name a few. Even with reservoir storage, competition for the limited supply of surface water resulted in conflicts over water rights, and during the 1930s rights to portions of the Pit River and many of its tributaries were defined in court decrees.

Department of Water Resources land-use surveys found that in 1955 about 44,000 acres were irrigated in Alturas Basin and that by 1979 about 53,000 acres were being irrigated. About 4,400 acre-feet of the 1979 irrigation requirement was met by pumped ground water. Much of the increase in irrigated lands was made possible by improved irrigation practices rather than development of new water supplies. As little unappropriated surface water remains, additional water demands will probably be met by more efficient use of water and additional use of ground water.

Waste Discharges

In the Alturas Basin major point source waste discharges have been limited to lumber mill wastes and domestic wastes from the City of Alturas. Additional domestic wastes are discharged through cesspools or septic tanks and leach fields in unsewered communities and at scattered locations over the watershed. As populations have remained low historically, domestic wastes have probably had limited impact on the mineral quality of the waters.

Nonpoint sources associated with agriculture (fertilizers, barnyard effluent, return irrigation flows, etc.) have probably had a greater impact on the water resources than point sources.

HYDROLOGY

The hydrology of the Alturas basin is affected by the diverse areal and seasonal distribution of precipitation, by large seasonal temperature variations, the influence of snowpack, the geologic and geographic features, and the use of surface and ground waters.

Precipitation

Although the mean annual precipitation along the crest of the Warner Mountains approaches 35 inches, the mean annual precipitation in the vicinity of Alturas is only about 13.4 inches and the basin is considered to be semi-arid. Most of the precipitation occurs between late fall and early spring and is stored as snowpack until the late spring thaw. There is generally a high runoff in spring and early summer when warmer temperatures melt the snow pack.

Surface Water

Numerous small streams drain the western slopes of the Warner Mountains and carry their annual water crop to the Pit River Valley. Water not diverted from these streams flows into the South or North Forks of the Pit River which converge near Alturas to form the Pit River. From there the Pit River flows westerly past Canby to Big Valley. The mean seasonal natural runoff in the Pit River near Canby at the lower end of the Alturas Basin has been estimated to be about 238,000 acre-feet.

The Pit River and its tributaries not only provide about 143,000 acre-feet annually for agricultural use, but also contribute significantly to the recharge of Alturas ground water basin.

Ground Water

The total ground water storage capacity in the Alturas Ground Water Basin to a depth of 800 feet has been estimated to be about 7,500,000 acre-feet. It is not presently known, however, how much of this quantity is usable or how much usable storage exists below 800 feet. The basin is divided into South Fork Pit River Subbasin and Warm Springs Valley Subbasin.

Occurrence

The principal water-bearing formations in Alturas Basin are Plio-Pleistocene and Pleistocene lava flows, the Alturas Formation, near-shore lake deposits, and Recent valley sedimentary deposits (see Figure 1). The Plio-Pleistocene lava flows, which are most prominent in the peripheral areas of the basin, are moderately permeable and, where exposed, provide an important recharge area.

The Alturas Formation is widespread and is the principal water-yielding formation in the basin. The sedimentary and volcanic rocks of this

formation have moderate to high permeability and, where saturated, yield sufficient ground water to wells for irrigation use. The formation contains both confined and unconfined ground water.

Extensive near-shore deposits occur on the east side of North Fork Pit River Valley. Minor areas of these deposits are also found locally at other locations in the basin. Although few wells have been drilled in these deposits, they appear to have moderate permeability.

Recent valley sedimentary deposits, which include alluvial fans, intermediate alluvium and basin deposits, are usually thin, being less than 50 feet thick. The alluvial fans are very permeable and usually provide high yields of confined and semiconfined water to wells. The intermediate alluvium has a somewhat lower permeability, but can provide moderate amounts of ground water to wells. Basin deposits with their very low permeability yield only small amounts of water.

Movement

Ground water movement in the basin generally follows the topography with water moving from the upland recharge areas that ring the valley down to the valley floor. Ground water in the South Fork Pit River Subbasin moves in a northerly direction towards Alturas. South of County Road 170 there is considerable recharge from irrigation water. From Alturas the ground water moves westerly into Warm Springs Valley Subbasin. In Warm Springs Valley, ground water migrates from the north, east, and south, then westerly along with the Pit River.

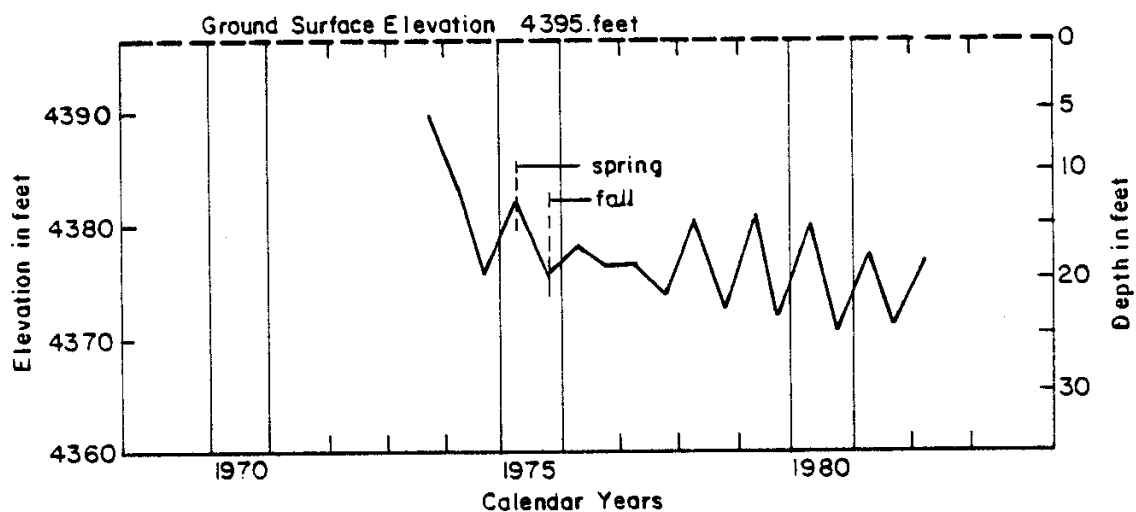
Levels

Ground water level measurements in wells show that ground water depths are usually less than 50 feet below the ground surface in the valley floor area. About half the measurements made in 1983 show the water table to be less than 25 feet below ground surface.

There has been a recent decline in ground water levels in some localized areas. Northeast of Alturas, levels dropped about five feet between 1975 and 1982 (see Figures 2, 3, and 4). Except in localized areas, spring water level measurements indicate little or no change in water levels.

Limited historic water level and pumpage data make it difficult to evaluate recent water table fluctuation or the lowering of the water table northeast of Alturas. Increased ground water pumpage and/or below normal recharge may be responsible for the lowering water levels. With increased ground water use, greater water level fluctuation should be expected with more movement of water into the areas of pumpage.

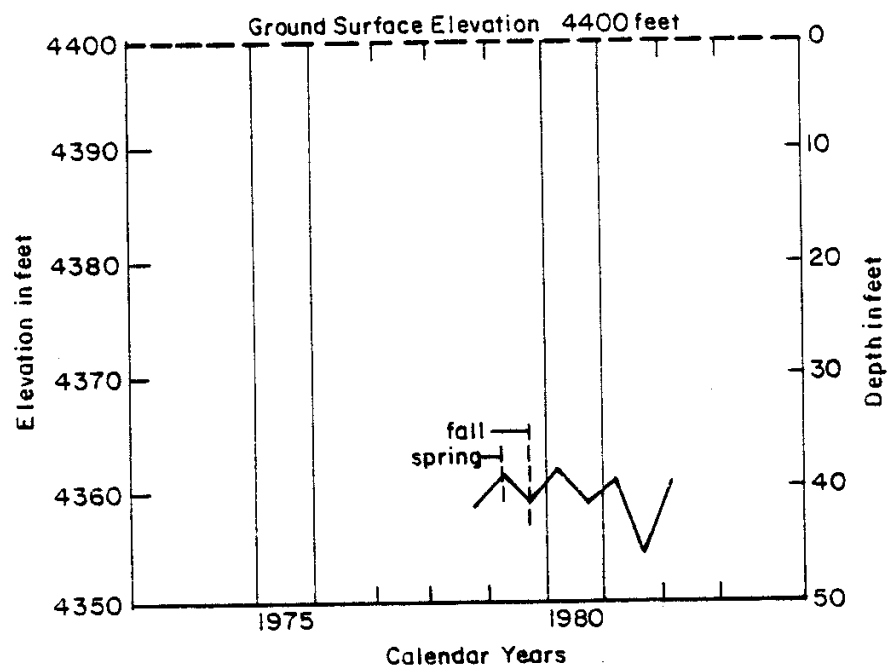
Figure 2



Well Number 42N/13E-6P2
 Well Depth 270 feet
 Well Use Irrigation
 Location Approximately 1.5 miles NE of
 junction Highway 299 and 395,
 1000 feet south of Highway 395
 in field.

Elevation changes in measured Well 6P2 Alturas

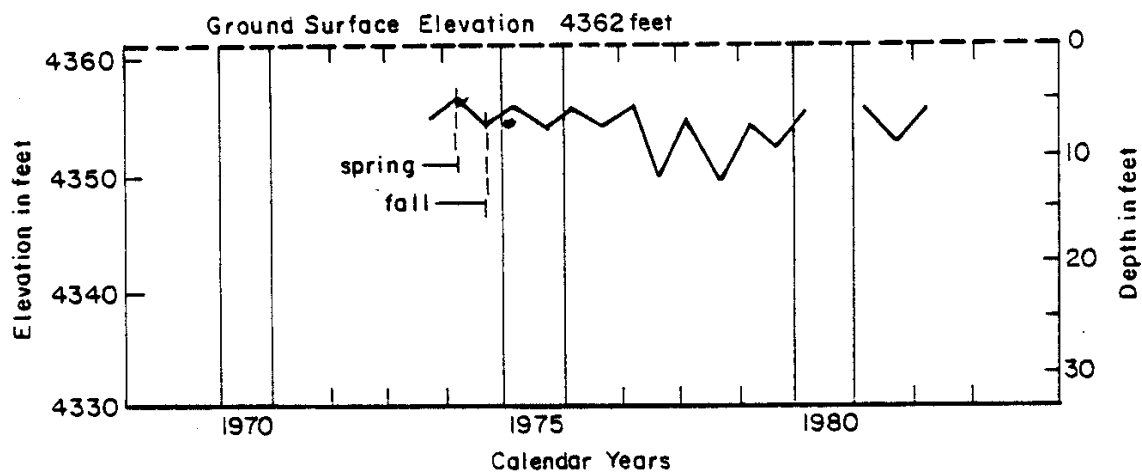
Figure 3



Well Number 41N/12E-15Q1
 Well Depth 300 feet
 Well Use Irrigation
 Location South of Alturas on County Road 60
 3.5 Miles; Well is west of road 2640 feet.

Elevation changes in measured Well 15Q1 Alturas

Figure 4



Well Number 42N/13E-3IP2
 Well Depth 400 feet
 Well Use Irrigation
 Location Approximately 3 miles SE
 of Alturas.
 Well is 1200 feet west
 of County Road 59A

Elevation changes in measured Well 3IP2 Alturas

WATER QUALITY

To determine the present quality of the Alturas Basin ground waters, sampling surveys were conducted in the summer of 1982 and spring of 1983. The Department of Water Resources' regular monitoring program wells were included so that present quality could be evaluated in relation to historic variation. The following sections present information on the water quality parameters, sampling and analytical procedures, and water quality criteria.

Water Quality Parameters

The suitability of ground water for beneficial use can be determined by its quality, which can be derived from a study of its chemical and physical characteristics.

Chemical

Precipitation, as it reaches the earth, is an excellent solvent. It contains dissolved gasses, such as carbon dioxide and oxygen, but normally contains few dissolved solids. As water passes through the hydrologic cycle, either on the surface or through the ground, it dissolves minerals from the materials it contacts. The amount and type of minerals dissolved reflect the composition of these materials and the hydrologic conditions governing the rate of water movement. Often, more salts and pollutants may be added by sewage, industrial wastes, and irrigation return flows. These dissolved substances can determine water's suitability for various beneficial uses.

A measure of the overall chemical quality can be obtained by determining and summing the concentrations of individual ions in a water. A measure of the total dissolved solids (TDS) can also be obtained by filtering a water sample, drying it, and weighing the residue. A third technique measures the electrical conductivity (EC) of the water sample, as that value can be related to the ionic content of the water. Ions commonly found in natural waters and most often looked for in laboratory analysis include calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, chloride, and boron. Each of these is important to one or more beneficial uses.

Another important chemical factor is pH, which is a measure of the water's acidity (hydrogen ion content). The pH scale ranges from 0 to 14, with a value of 7 being neutral. Most natural waters have a pH in the 6.5 to 8.5 range, while an acid, such as lemon juice, has a pH of about 2, and household ammonia has a pH of about 12.

Alkalinity is a measure of a water's ability to withstand changes in pH and is due to the carbon dioxide, bicarbonate, and carbonate equilibrium in the water. The buffering action of this equilibrium is important because it dampens pH fluctuations that might occur due to waste discharges or intense algal growth. It also serves as a source of inorganic carbon for plant growth.

Water contains varying amounts of certain elements which are essential to biologic productivity and are referred to as nutrients. Such metals as iron, copper, molybdenum, etc., are needed in trace amounts and are called

micronutrients. Carbon, nitrogen, and phosphorus are needed in larger quantities and are referred to as macronutrients. The two elements most often considered limiting to primary productivity in aquatic systems (if there were more of that element present, there would be more growth) are nitrogen and phosphorus.

Nitrogen is found in water in the form of nitrate, nitrite, and ammonium ions, ammonia gas, or as part of nitrogen-bearing organic compounds. Nitrate is the form most commonly found in ground water.

Phosphorus is found in water as orthophosphates, polyphosphates, and organic phosphorus. Most forms are converted in nature to orthophosphates by bacterial action or hydrolysis, and this is the form used by organisms. Both orthophosphate and total phosphorus levels are generally included in nutrient determinations.

Physical

Temperature, color, and odor are important physical characteristics of water. Temperature greatly influences the suitability of water for many beneficial uses. It affects the solubility of gases, and other substances in water, water density, and its viscosity. Color and odor characteristics affect the potability of water and are important to its domestic use.

Sampling and Analytical Methods

Ground water samples were collected during this study in sample-rinsed plastic bottles. Samples were collected from taps at the wells or from the nearest possible point in the distribution systems. Whenever possible, samples were collected from systems when pumps had been operating for a period of time so that its quality would represent the well's source aquifer. Temperature, pH, and EC measurements were made at the time of sampling, and additional samples were collected for analyses at the Department's chemical laboratory in Bryte.

Temperatures were measured with standard field thermometers whose calibrations had been checked in the laboratory.

Field pH was determined by using Hellige Comparitors with appropriate indicator solution and disk. Laboratory pH's were also measured in selected samples with a calibrated glass electrode-type pH meter.

Electrical conductivity was measured on portable Beckman solubridges that had been calibrated on known solutions. Selected samples that were sent to the laboratory also had EC determinations made for quality control.

Samples collected for standard mineral or special constituent determinations were transported to the Bryte Laboratory for analysis. Table 1 lists the standard methods used at that laboratory.

Trace metal samples were collected in special acid-rinsed plastic bottles. Double distilled nitric acid was added to reduce the pH to 3 and samples were transported to the laboratory.

TABLE 1
ANALYTICAL METHODS
FOR WATER QUALITY PARAMETERS

<u>Parameter</u>	<u>Method</u>
Electrical Conductivity	Beckman Wheatstone Bridge
Total Hardness	Ca, Mg Atomic Absorption Spectrophotometric
Sodium	Atomic Absorption Spectrophotometric
Potassium	Atomic Absorption Spectrophotometric
Sulfate	Gravimetric - AWWA
Chloride	Automated Ferricyanate Method
Boron	Carminic - AWWA
Arsenic	Silver Diethyl - AWWA
Barium	Atomic Absorption Spectrophotometric
Cadmium	Atomic Absorption Spectrophotometric
Chromate	Atomic Absorption Spectrophotometric
Copper	Atomic Absorption Spectrophotometric
Iron	Atomic Absorption Spectrophotometric
Lead	Atomic Absorption Spectrophotometric
Manganese	Atomic Absorption Spectrophotometric
Zinc	Atomic Absorption Spectrophotometric
Mercury	Cold Vapor Atomic Absorption - EPA
Dissolved Nitrate	Automated Cadmium Reduction
Total Ammonia	Automated Phenate
Total Organic Nitrogen	Block Digestor Phenate
Dissolved Phosphate	Automated Ascorbic Acid
Total Phosphate	Block Digestor Ascorbic Acid

Water Quality Criteria

As the two major beneficial uses of ground water in this basin are domestic and agriculture, water quality criteria for each were used in the water quality evaluations. Sanitary surveys and bacteriological sampling were beyond the scope of this investigation and evaluations were based solely on chemical and physical characteristics.

Criteria presented in the following sections have been utilized in the evaluations. Except for the constituents that are considered toxic to humans, the concentrations included in the criteria should be considered as suggested limiting values. A water that contains constituent concentrations exceeding these values need not be eliminated from consideration as a source of supply, but should be used with caution and other sources of better quality water should be investigated.

Domestic and Municipal Water Supply

The criteria used in this report for evaluating ground water for domestic use are those included in the State of California domestic water regulations for chemical and physical quality.

Water containing contaminants exceeding the maximum contaminant levels shown in Tables 2, 3, and 4 presents a risk to the health of humans when continually used for drinking or culinary purposes.

TABLE 2

MAXIMUM CONTAMINANT LEVELS
INORGANIC CHEMICALS

<u>Constituent</u>	<u>Maximum Contaminant Level, mg/L</u>
Arsenic	0.05
Barium	1.
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as NO ₃)	45.
Selenium	0.01
Silver	0.05

TABLE 3

MAXIMUM CONTAMINANT LEVELS
ORGANIC CHEMICALS

<u>Constituent</u>	<u>Maximum Contaminant Level, mg/L</u>
(a) Chlorinated Hydrocarbons	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
(b) Chlorophenoxys	
2, 4 - D	0.1
2,4,5 - TP Silvex	0.01

TABLE 4

LIMITING CONCENTRATIONS FOR FLUORIDE

<u>Annual Average of Maximum Daily Air Temperature</u>		<u>Fluoride Concentration, mg/L</u>			
<u>Degrees Fahrenheit</u>	<u>Degrees Celsius</u>	<u>Lower</u>	<u>Optimum</u>	<u>Upper</u>	<u>Maximum Contaminant Level</u>
53.7 and below	12.0 and below	0.9	1.2	1.7	2.4
53.8 to 58.3	12.1 to 14.6	0.8	1.1	1.5	2.2
58.4 to 63.8	14.7 to 17.6	0.8	1.0	1.3	2.0
63.9 to 70.6	17.7 to 21.4	0.7	0.9	1.2	1.8
70.7 to 79.2	21.5 to 26.2	0.7	0.8	1.0	1.6
79.3 to 90.5	26.3 to 32.5	0.6	0.7	0.8	1.4

Water containing substances exceeding the maximum contaminant levels shown in Tables 5 and 6 may be objectionable to an appreciable number of people, but is not generally hazardous to health.

TABLE 5

CONSUMER ACCEPTANCE LIMITS
SECONDARY DRINKING WATER STANDARDS

<u>Constituents</u>	<u>Maximum Contaminant Levels</u>
Color	15 Units
Copper	1.0 mg/L
Corrosivity	Relatively low
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor - Threshold	3 units
Foaming Agents (MBAS)	0.5 mg/L
Turbidity	5 units
Zinc	5.0 mg/L

TABLE 6

MINERALIZATION
SECONDARY DRINKING WATER STANDARDS

<u>Constituent, Units</u>	<u>Maximum Contaminant Levels</u>		
	<u>Recommended</u>	<u>Upper</u>	<u>Short Term</u>
Total Dissolved Solids, mg/L	500	1,000	1,500
or			
Specific Conductance, micromhos	900	1,600	2,200
Chloride, mg/L	250	500	600
Sulfate, mg/L	250	500	600

Water Quality for Agriculture

Prior to 1974, the Department of Water Resources used water quality criteria for the suitability of water for irrigation, which had been developed by the University of California, and classified waters into three groups: Class I (excellent to good), Class II (good to injurious) and Class III (injurious to unsatisfactory). As these criteria were used, it became apparent that they were too general and not applicable in some instances.

To provide improved criteria, a University of California Committee of Consultants formulated a group of guidelines for the interpretation of water quality for agriculture in the early 1970s. These 1970 guidelines have been used by the Department of Water Resources since that time and were used during this investigation. These guidelines are summarized in Table 7 and the complete guidelines are presented in Appendix A.

Guidelines for Interpretation of Quality of Water for Irrigation

Interpretations are based on possible effects of constituents on crops and/or soils. Guidelines are flexible and should be modified when warranted by local experience or special conditions of crop, soil, and method of irrigation.

TABLE 7

<u>PROBLEMS AND RELATED CONSTITUENT</u>	<u>WATER QUALITY GUIDELINES</u>		
	<u>No Problem</u>	<u>Increasing Problems</u>	<u>Severe Problems</u>
<u>Salinity^{1/}</u>			
EC _w of irrigation water, in millimhos/cm	<0.75	0.75-3.0	>3.0
<u>Permeability</u>			
EC _w of irrigation water, in mmho/cm	>0.5	<0.5	<0.2
adj.SAR ^{2/}	<6.0	6.0-9.0	>9.0
<u>Specific Ion Toxicity^{3/}</u>			
<u>from ROOT absorption</u>			
Sodium (evaluate by adj.SAR)	<3	3.0-9.0	>9.0
Chloride (me/L)	<4	4.0-10	>10
(mg/L or ppm)	<142	142-355	>355
Boron (mg/L or ppm)	<0.5	0.5-2.0	2.0-10.0
<u>from FOLIAR absorption^{4/} (sprinklers)</u>			
Sodium (me/L)	<3.0	>3.0	--
(mg/L or ppm)	<69	>69	--
Chloride (me/L)	<3.0	>3.0	--
(mg/L or ppm)	<106	>106	--
<u>Miscellaneous^{5/}</u>			
NH ₄ -N mg/L	<5	5-30	>30
or for sensitive crops			
NO ₃ -N ppm			
HCO ₃ (me/L)	<1.5	1.5-8.5	>8.5
(mg/L (only with overhead sprinklers)	<90	90-520	>520
or			
ppm)			
pH	normal range = 6.5-8.4 --		

- 1/ Assumes water for crop plus needed water for leaching requirement (LR) will be applied. Crops vary in tolerance to salinity. Refer to tables for crop tolerance and LR. (mmho/cmX640 = approximate total dissolved solids (TDS) in mg/L or ppm; mmhoX1000 = micromhos).
- 2 adj.SAR (Adjusted Sodium Adsorption Ratio) is calculated from a modified equation developed by U. S. Salinity Laboratory to include added effects of precipitation or dissolution of calcium in soils and related to CO₃ + HCO₃ concentrations.

To evaluate sodium (permeability) hazard:

$$\frac{\text{Na}}{\sqrt{\frac{\text{Ca} + \text{Mg}}{2}}} [1 + (8.4 \text{ pHc})]$$

pHc is a calculated value based on total cations. Ca + Mg, and CO₃ + HCO₃. Calculating and reporting will be done by reporting laboratory.

NOTE: NA, CA+MG, CO₃+HCO₃ should be in me/L.

Permeability problems, related to low LC or high adj.SAR of water, can be reduced if necessary by adding gypsum. Usual application rate per acre-foot of applied water is from 200 to about 1,000 lbs. (234 lbs of 100% gypsum added to 1 acre-foot of water will supply 1 me/L of calcium and raise the EC_w about 0.1 mmho.) In many cases a soil application may be needed.

- 3/ Most tree crops and woody ornamentals are sensitive to sodium and chloride (use values shown). Most annual crops are not sensitive (use salinity tolerance tables). For boron sensitivity, refer to boron tolerance tables.
- 4/ Leaf areas wet by sprinklers (rotating heads) may show a leaf burn due to sodium or chloride absorption under low humidity, high-evaporation conditions. (Evaporation increases ion concentration in water films on leaves between rotations of sprinkler heads.)
- 5/ Excess N may affect production or quality of certain crops, e.g. sugar beets, citrus, avocados, apricots, grapes, etc. (1 mg/L NO₃-N = 2.72 lbs, N/acre-foot of applied water.) HCO₃ with overhead and sprinkler irrigation may cause a white carbonate deposit to form on fruit and leaves.

<u>Symbol</u>	<u>Name</u>	<u>Symbol</u>	<u>Name</u>	<u>Equiv. Wt.</u>
EC _w	Electrical Conductivity of water	Na	Sodium	23.00
mmho/cm	millimho per centimeter	Ca	Calcium	20.04
<	less than	Mg	Magnesium	12.16
>	more than	CO ₃	Carbonate	30.00
mg/L	milligrams per liter	HCO ₃	Bicarbonate	61.00
ppm	parts per million	NO ₃ -N	Nitrate-nitrogen	14.00
LR	Leaching Requirement	Cl	Chloride	35.45
me/L	milliequivalents per liter			
TDS	Total Dissolved Solids			17.1 ppm = 1 grain per gallon

STUDY RESULTS

During this study Alturas Basin's current well and ground water quality data were combined with historic data to get a better understanding of the present ground water quality and detect changes that may have occurred. Well data used in this study are presented in Appendix B. Both current and historic water quality data have been included in Appendices C and D. Each well has been numbered according to the California State Well Numbering System and data in the appendices are listed by that number. All data have also been entered in the Department of Water Resources' data storage and retrieval system (WDIS) so that it is available for dissemination and updating.

The well numbering system uses the township, range, and section subdivisions of the Public Land Survey as its base. Each section is then divided into sixteen 40 acre tracts, lettered as follows:

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Well Number
16N/3E-17K1M

Wells are numbered within each 40-acre tract according to the chronological sequence in which they have been assigned California State well numbers. For example, a well which has the number 16N/3E-17K1M would be in Township 16 North, Range 3 East, Section 17 of the Mount Diablo (M) Base and Meridian. K1 further designates it as the first well assigned a State well number in Tract K. The location of the wells utilized in this study are shown on Plate 1.

Water Quality Characteristics

Alturas Basin ground waters are generally of good mineral quality with total dissolved solids (TDS) contents ranging from about 100 to 1600 milligrams per litre (mg/L). Analyses indicate that the well waters have a median TDS concentration of about 260 mg/L and that few wells have concentrations exceeding 500 mg/L. Electrical Conductivity (EC) of 141 well waters ranged from 76 to 2400 micromhos per centimetre at 25 degrees C ($\mu\text{mhos/cm}$) with a median of 315 $\mu\text{mhos/cm}$. The EC measurements show higher concentrations in the central portions of the basin, and are probably related to the lake deposits of the Alturas Formation and the structural systems that formed the basin. EC's in the fringe areas and recharge areas of the basin are low, reflecting the excellent quality of the recharge water. The EC contours (Plate 2) generally follow the surface topography as do the ground water contours.

A comparison of historic and recent EC records showed no discernible trend of change in the basin. Most well waters showed little or no change. Four wells produced water with increased levels of EC during the current sampling while three others showed decreased levels. These changes are in the range of those that should be expected in a basin such as this, with seasonally fluctuating water levels that have been lowered by increased pumping.

The ground waters of this basin are generally sodium bicarbonate in character. In the northeast portion of the basin near Alturas and in the western end of the basin near Canby, well waters are found with higher levels of calcium and magnesium. Most of the well waters are strongly bicarbonate in character, but eight wells produce water that is sodium sulfate in character.

Chlorides

Throughout the basin, chloride levels in the ground waters are generally low. Concentrations in waters from seventy wells ranged from 0 to 271 mg/L with a median of only 8 mg/L. Chlorides only exceeded 50 mg/L in eight wells and most of these are known to draw water from the lake sediments of the Alturas Formation.

Sulfates

Sulfate concentrations are quite variable in the ground waters of Alturas Basin. Analysis of waters from over 90 wells show a range of 0 to 626 mg/L with a median concentration of 16 mg/L. As shown by the median value of 16 mg/L, most of the well waters contain low levels of sulfates; however, twelve wells waters contained concentrations exceeding 100 mg/L, with four of these exceeded 250 mg/L. Most of the wells producing sulfate waters are located in the southwestern portion of the basin between Alturas and Canby and obtain water from the Alturas Formation.

Alkalinity and pH

Alkalinity levels in Alturas Basin ground waters, when expressed as calcium carbonate, ranged from 37 to 487 mg/L, while pH values ranged from 7.0 to 8.5. These levels are within the expected range for good quality bicarbonate type waters and should provide good buffering against sudden pH impacts.

Hardness

Alturas Basin well waters range in hardness from 2 to 506 mg/L (expressed as calcium carbonate) with a median of 76 mg/L. Most of these waters are considered soft; however, in the northeast portion of the basin, near Alturas, there is an extensive area of hard water. There are six wells scattered throughout the basin that produce very hard water with hardness exceeding 300 mg/L. These all obtain water from the Alturas Formation and are located along known or suspected geologic faults.

Sodium Adsorption Ratio

The Adjusted Sodium Adsorption Ratio, (ASAR), is a useful factor in evaluating the hazard related to changes in permeability and resultant salt build up caused by high concentrations of sodium. Levels above 3 can cause increasing problems and levels greater than 9 can cause severe problems. The ASAR values for Alturas Basin well waters ranged from 0 to 23.9 with a median value of 2.3. Ten wells of 118 had ASAR values exceeding 9. These wells obtain water from the Alturas Formation generally in areas where it is a confined aquifer and in the vicinity of known or suspected geologic faults.

Boron

Boron (B) appears to pose no widespread problems in the overall condition of the Alturas Basin's ground water. However, four wells produce waters with boron concentrations exceeding 2 mg/L. Three of them are closely spaced in the same geologic formation, the Alturas Formation (confined). Nearby wells in different formations and others in the same formation (Alturas) do not have high levels of boron. The low boron concentration in the basin ground water is 0.0 mg/L, the median level is 0.03 mg/L, and the high is 4.6 mg/L.

There appears to be no real trend of change in the Alturas Basin's general boron levels, from a comparison of historic and current data.

Nitrates

Nitrate (NO_3) levels in the well waters of Alturas Basin are generally low. Isolated incidences of high NO_3 have occurred, but are not connected spatially or chronologically. Of 16 wells recently monitored for NO_3 , none exceeded recommended limits (45 mg/L as NO_3). They ranged in value from 0 to 38 mg/L, with a median value of 4.2 mg/L (16 wells).

Historic data revealed two wells producing water with nitrate concentrations exceeding 45 mg/L. A concentration of 310 mg/L was found in water from well 41N/11E-5L1, while water from 41N/12E-2N1 contained 80 mg/L. These were isolated occurrences apparently caused by local impairment, and do not reflect the general ground water conditions in the Alturas Basin.

Suitability for Beneficial Use

Though the general ground water quality of Alturas Basin is good, there are some localized problems that are limiting water's beneficial uses. Most of these poorer quality waters are from wells that draw from confined portions of the Alturas Formation, and/or from water migrating along faults. Water quality problems associated with these waters include high EC, ASAR, sulphate, boron, and, in one case, chloride. These limit domestic and irrigation uses. Plate 1 shows the well locations and suitability of well water for beneficial use. Plate 2 shows a map of EC contours for the basin.

Domestic

Eight wells in Alturas Basin have produced poor quality water with concentrations of dissolved solids exceeding the recommended levels for domestic use (see Plate 1). Water from well 41N/11E-3E1 also contains concentrations of sulfate and chloride that exceed recommended levels for domestic use. Wells 41N/10E-11B1 and 41N/11E-4J1 produced waters with sulfate concentrations exceeding recommended levels. Although these wells are in scattered locations throughout the basin, they each obtain ground water from the upper Alturas Formation in the vicinity of known or suspected fault zones.

Irrigation

Of the eight wells which produce water not meeting drinking water standards, seven yield water having ASAR values exceeding nine, which indicates that their use for irrigation could cause severe problems. Four additional well waters had excessive ASAR values and these wells are also shown on Plate 1. Water from wells 42N/10E-29A1, 42N/12E-23N1, 42N/12E-26P1, and 42N/13E-31P2 not only have excessive ASAR values, but contain boron concentrations exceeding 2 mg/L, which indicates they can be damaging to most crops. Each of these wells also draws water from the upper Alturas Formation in the vicinity of known or suspected fault zones.

FINDINGS

The most significant findings about water in the Alturas Basin are:

1. The surface water resources of the Alturas Basin are not sufficient to last through the entire irrigation season.
2. The ground water resources of the Alturas Basin must be relied upon to supplement the surface supply from July through September.
3. Pumpage of ground water in the Alturas Basin in 1979 was about 4,400 acre-feet.
4. Most recharge occurs in the upland recharge areas of Devils Garden, Portuguese Ridge, and the western slope of the Warner Mountains.
5. Secondary recharge occurs from the Pit River and other streams tributary to the basin.
6. The direction of the movement of ground water in the basin follows the topography of the basin.
7. Alturas Basin ground waters are generally of good mineral quality and suitable for most domestic and agricultural uses.
8. Alturas Basin ground waters are generally sodium bicarbonate in character.
9. Data from 141 wells indicate that eight wells produce water with dissolved solids concentrations which exceed levels recommended for domestic use.
10. Data from 141 wells indicate that 11 wells produce water which could cause severe problems if used for irrigation.
11. The mineral quality of the ground water coming from springs and artesian wells in the fringe areas and near recharge areas is usually excellent.
12. The median electrical conductivity of the ground water sampled in Alturas Basin is 335 μ mhos/cm.
13. The median chloride concentration of the ground water sampled in Alturas Basin was 8 mg/L with only one well water exceeding 250 mg/L.
14. The median sulfate concentration in the ground waters of Alturas Basin was 16 mg/L, but four well waters contained concentrations exceeding 250 mg/L.
15. The median boron concentration in Alturas Basin ground water was 0.03 mg/L with four well waters exceeding 2 mg/L.

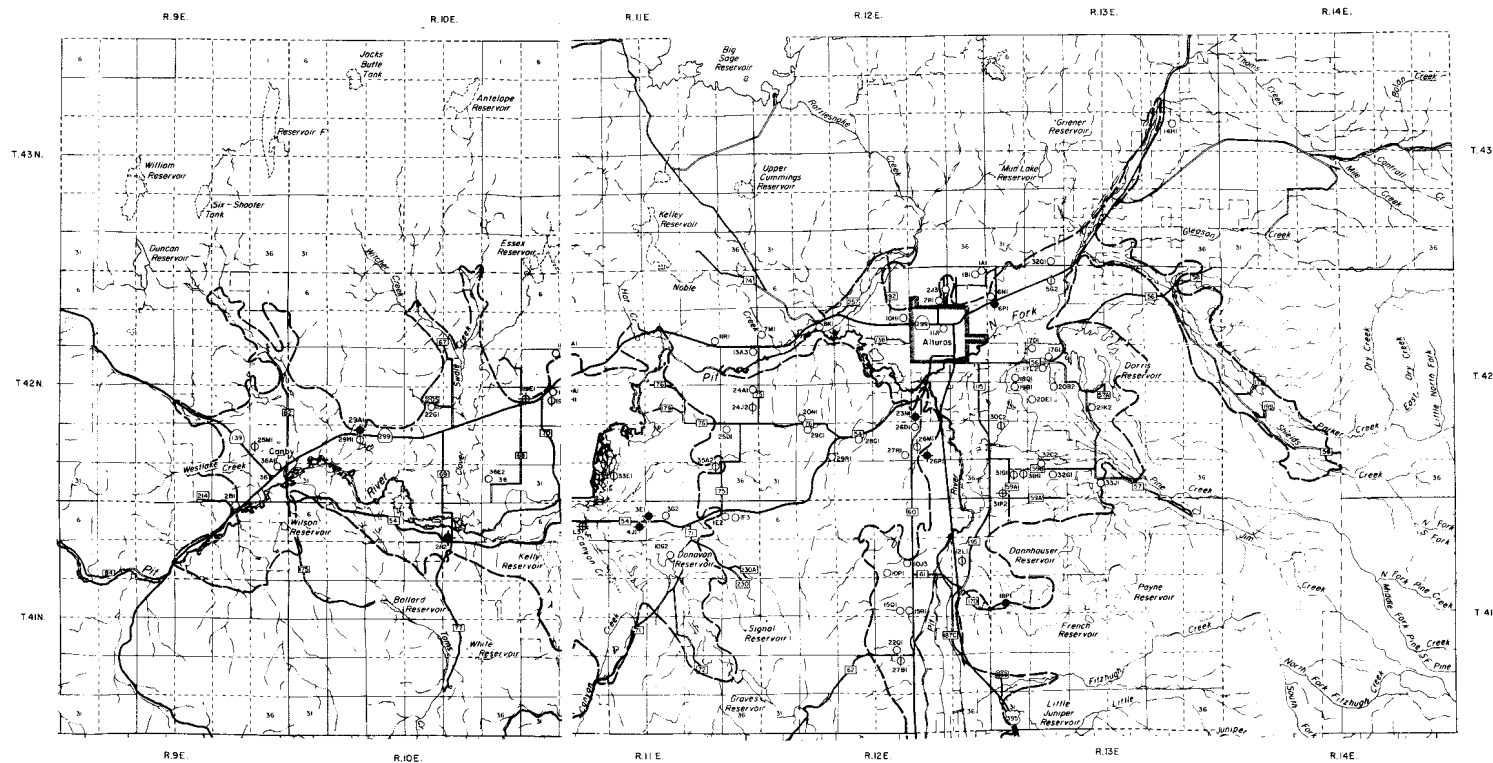
CONCLUSIONS

This investigation has resulted in the following conclusions:

1. Any further water resource development in the Alturas basin will probably be dependent on ground water.
2. Although ground water quality changes have occurred in a few well waters, there are no significant trends of change in the ground waters of the basin.
3. Well waters obtained from some of the confined areas of the upper Alturas Formation can be expected to be poor in quality and are not recommended for domestic or irrigation use.
4. New wells that draw water from the upper Alturas Formation should have the water quality checked before it is utilized.
5. Monitoring of both ground water levels and quality should be continued in this basin.
6. Recharge areas should be protected from extensive development which could interfere with recharge or result in ground water pollution.

REFERENCES

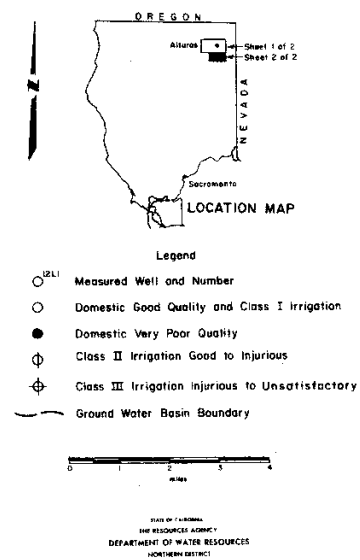
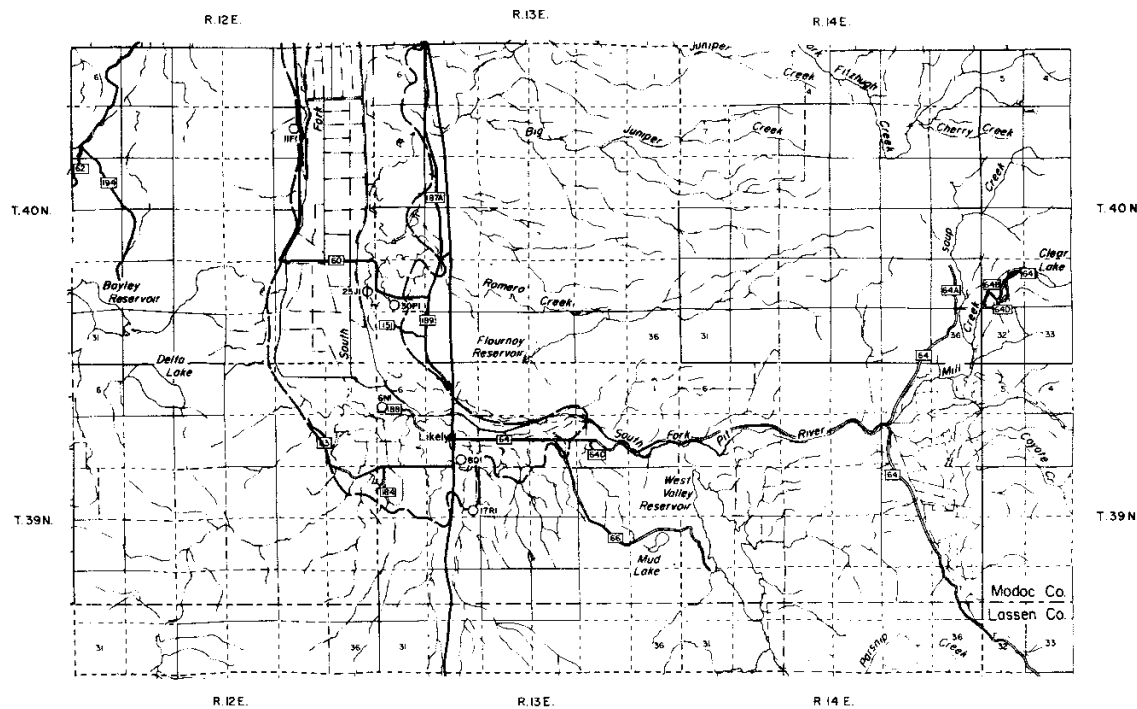
- California Department of Water Resources. "Water Resources of California".
Bulletin 1. 1951.
- . "Water Quality Investigation : Alturas and Warm Springs Valley
Basins".
April 1960.
- . "Northeastern Counties Investigation". Bulletin 58. June 1960.
- . "Northeastern Counties Ground Water Investigation". Bulletin 98,
Vol. I. February 1963.
- . "Hydrologic Data : 1975". Bulletin 130-75. Vol. II : Northeastern
California. May 1977.
- . "Watermaster Service in Northern California, 1980 Season".
December 1981.
- . "Northeastern Counties Ground Water Update, 1982". 1982.
- . "Water Quality Investigation : Pit River". 1983.
- Lantis, David, Rodney Steiner, and Arthur Karinen. "California : Land of
Contrast". Kendall-Hunt Publishing Company. 1977.
- Modoc County. "The General Plan -- an Interim Guide for Development -- Modoc
County". 1965.
- . "Natural Resources Elements (Conservation, Open Space, Recreation) of
the General Plan". 1974.
- National Oceanic and Atmospheric Administration. "Climatological Data :
California". Volumes 85-86. January 1981 - December 1982.
- United States Geological Survey. "Water Resources Data - California, Water
Year 1981". Vol. 4. 1982.
- University of California Cooperative Extension. "Water Quality - Guidelines
for Interpretation of Water Quality for Agriculture". 1975.



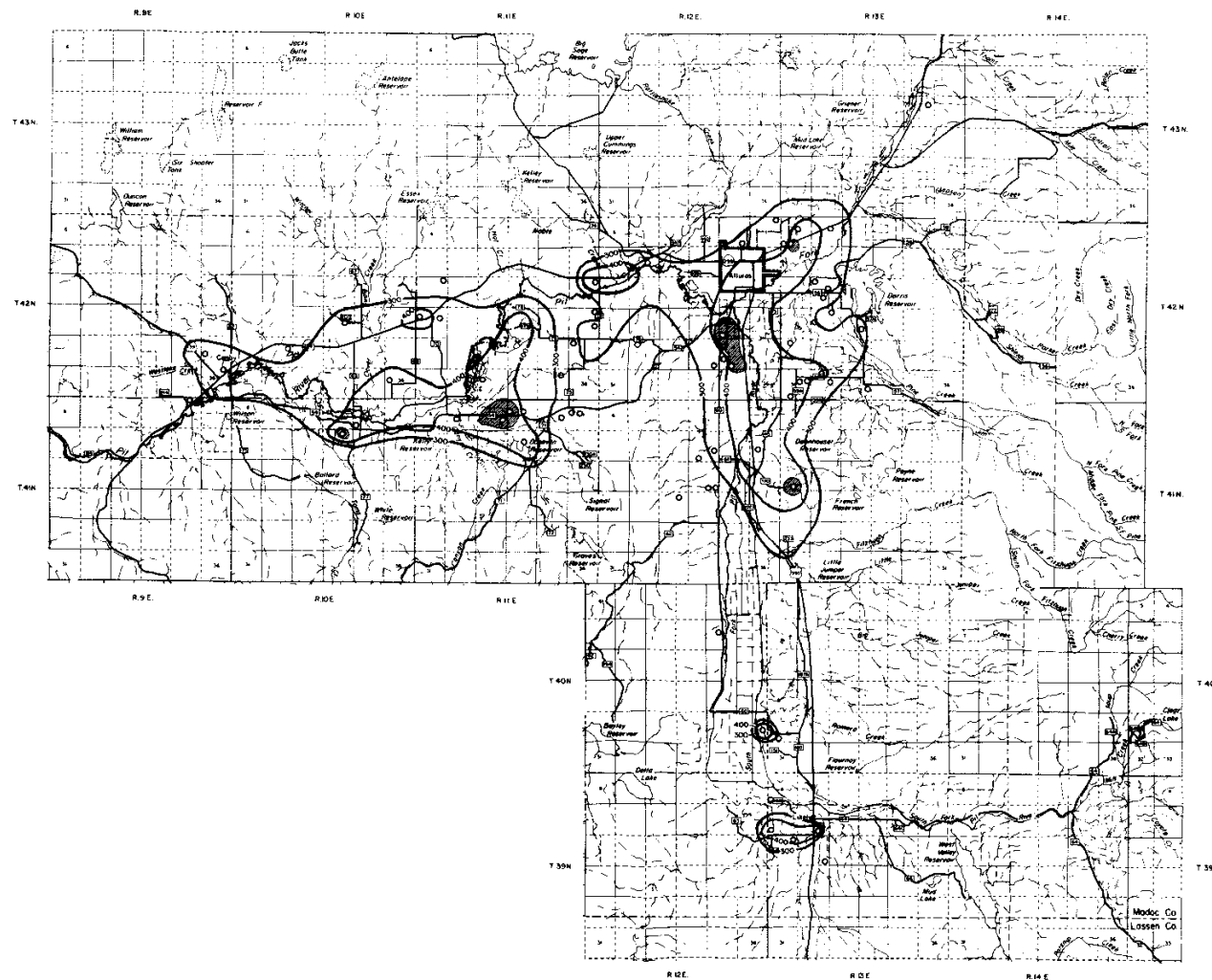
- Legend
- Measured Well and Number
 - Domestic Good Quality and Class I Irrigation
 - Domestic Very Poor Quality
 - ⊕ Class II Irrigation Good to Injurious
 - ⊕ Class III Irrigation Injurious to Unsatisfactory
 - Ground Water Basin Boundary



Well Location
Alturas Ground Water Basin
Water Quality Study
1986



Well Location
Alturas Ground Water Basin
Water Quality Study
1986



- Legend
- Data Well
 - Exceeds Recommended E.C. Limit (900)
 - Conductivity Isolines

Note: Electrical Conductivity
(umhos/cm² @ 25°C)



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

Electrical Conductivity
Alturas Ground Water Basin
Water Quality Study
1986

APPENDIX A
WATER QUALITY CRITERIA

WATER QUALITY

Guidelines for Interpretation of Water Quality for Agriculture (UC-Committee of Consultants)

Guidelines were originally distributed to Cooperative Extension staff in December 1973. Suggestions for needed changes, additions, and corrections have been made as received. The present "guidelines" are revised to January 15, 1975 and include -

1. Guidelines for Interpretation of Quality of Water for Irrigation.
2. Assumptions and Comments on "Guidelines".
3. Crop Tolerance and Leaching Requirement Tables - Field Crops.
4. " " " " " " --Vegetable Crops.
5. " " " " " " - Fruit Crops
6. " " " " " " - Forage Crops
7. Example - Use of Crop Tolerance Tables.
8. Boron in Irrigation Waters.
9. Tolerance of Ornamental Shrubs and Ground Covers to Salinity in Irrigation Water.
10. Recommended Maximum Concentrations of Trace Elements in Irrigation Waters.
11. Guide to Use of Saline Waters for Livestock and Poultry.
12. Guidelines To Levels of Toxic Substances in Drinking Water For Livestock.
13. Tables for Calculating pHc Values of Waters.

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Guidelines for Interpretation of Quality of Water for Irrigation

Interpretations are based on possible effects of constituents on crops and/or soils. Guidelines are flexible and should be modified when warranted by local experience or special conditions of crop, soil, and method of irrigation.

TABLE A-1

<u>PROBLEM AND RELATED CONSTITUENT</u>	<u>WATER QUALITY GUIDELINES</u>		
	<u>No Problem</u>	<u>Increasing Problems</u>	<u>Severe Problems</u>
<u>Salinity</u> ^{1/}			
EC _w of irrigation water, in millimhos/cm	<0.75	0.75-3.0	>3.0
<u>Permeability</u>			
EC _w of irrigation water, in mmho/cm	>0.5	<0.5	<0.2
adj. SAR ^{2/}	<6.0	6.0-9.0	>9.0
<u>Specific Ion Toxicity</u> ^{3/}			
<u>from ROOT absorption</u>			
Sodium (evaluate by adj. SAR)	<3	3.0-9.0	>9.0
Chloride (me/L)	<4	4.0-10	>10
(mg/L or ppm)	<142	142-355	>355
Boron (mg/L or ppm)	<0.5	0.5-2.0	2.0-10.0
<u>from FOLIAR absorption</u> ^{4/} (sprinklers)			
Sodium (me/L)	<3.0	>3.0	--
(mg/L or ppm)	<69	>69	--
Chloride (me/L)	<3.0	>3.0	--
(mg/L or ppm)	<106	>106	--
<u>Miscellaneous</u> ^{5/}			
NH ₄ ⁺ -N } mg/L	<5	5-30	>30
NO ₃ ⁻ -N } or for sensitive crops			
ppm			
HCO ₃ ⁻ (me/L)	<1.5	1.5-8.5	>8.5
(mg/L) (only with overhead sprinklers)	<90	90-520	>520
or			
ppm)			
pH	normal range = 6.5-8.4 --		

- 1/ Assumes water for crop plus needed water for leaching requirement (LR) will be applied. Crops vary in tolerance to salinity. Refer to tables for crop tolerance and LR. (mmho/cmX640 = approximate total dissolved solids (TDS) in mg/L or ppm; mmhoX1000 = micromhos)
- 2/ adj.SAR (Adjusted Sodium Adsorption Ratio) is calculated from a modified equation developed by U. S. Salinity Laboratory to include added effects of precipitation or dissolution of calcium in soils and related to $\text{CO}_3 + \text{HCO}_3$ concentrations.

To evaluate sodium (permeability) hazard:

$$\frac{\text{Na}}{\sqrt{\frac{\text{Ca} + \text{Mg}}{2}}} [1 + (8.4 \text{ pHc})]$$

pHc is a calculated value based on total cations. Ca + Mg, and $\text{CO}_3 + \text{HCO}_3$. Calculating and reporting will be done by reporting laboratory.

NOTE: Na, Ca+Mg, $\text{CO}_3 + \text{HCO}_3$ should be in me/L.

Permeability problems, related to low LC or high adj.SAR of water, can be reduced if necessary by adding gypsum. Usual application rate per acre-foot of applied water is from 200 to about 1,000 lbs. (234 lbs of 100% gypsum added to 1 acre-foot of water will supply 1 me/L of calcium and raise the EC_w about 0.1 mmho.) In many cases a soil application may be needed.

- 3/ Most tree crops and woody ornamentals are sensitive to sodium and chloride (use values shown). Most annual crops are not sensitive (use salinity tolerance tables). For boron sensitivity, refer to boron tolerance tables.
- 4/ Leaf areas wet by sprinklers (rotating heads) may show a leaf burn due to sodium or chloride absorption under low humidity, high-evaporation conditions. (Evaporation increases ion concentration in water films on leaves between rotations of sprinkler heads.)
- 5/ Excess N may affect production or quality of certain crops, e.g. sugar beets, citrus, avocados, apricots, grapes, etc. (1 mg/L $\text{NO}_3\text{-N}$ = 2.72 lbs, N/acre-foot of applied water.) HCO_3 with overhead sprinkler irrigation may cause a white carbonate deposit to form on fruit and leaves.

<u>Symbol</u>	<u>Name</u>	<u>Symbol</u>	<u>Name</u>	<u>Equiv.</u> <u>Wt.</u>
EC_w	Electrical Conductivity of water	Na	Sodium	23.00
mmho/cm	millimho per centimeter	Ca	Calcium	20.04
<	less than	Mg	Magnesium	12.16
>	more than	CO_3	Carbonate	30.00
mg/L	milligrams per liter	HCO_3	Bicarbonate	61.00
ppm	parts per million	$\text{NO}_3\text{-N}$	Nitrate-nitrogen	14.00
LR	Leaching Requirement	Cl	Chloride	35.45
me/L	milliequivalents per liter			
TDS	Total Dissolved Solids			

17.1 ppm = 1 grain per gallon

Assumptions and Comments on Guidelines for Interpretation of Quality of Water for Irrigation Developed by University of California Committee of Consultants

1. These "guidelines" are flexible and intended for use in estimating the potential hazards to crop production associated with long-term use of the particular water being evaluated. Guidelines should be modified when warranted by local experience and special conditions of crop, soil, method of irrigation, or level of soil-water-crop management. Changes of 10 to 20 percent above or below an indicated guideline value may have little significance if considered in proper perspective along with all other variables that enter into a yield of crop.
2. It is assumed that the water will be used under average conditions-- soil texture, internal drainage, total water use, climate, and salt tolerance of crop. Large deviations from the average might make it unsafe to use water which under average conditions would be good, or might make it safe to use water, which under average conditions would be of doubtful quality.
3. The divisions into "No problem--Increasing Problem--Severe Problem" is more-or-less arbitrary, as well as carefully controlled greenhouse and small plot research conducted by various researchers over the past 40 years or more. Guidelines of one sort or another have been proposed by U. S. Geological Survey, University of California, U. S. Salinity Laboratory, and many others starting as early as 1911. As new research and observations have developed additional information for assessing water quality, guidelines have been modified.
4. These guidelines apply to surface irrigation methods such as furrow, flood, basin, sprinklers, or any other which applies water on an "as-needed" basis and which allows for an extended dry-down period between

irrigations during which the crop uses up a considerable portion of the available stored water.

5. The guidelines incorporate some of the newer concepts in soil-plant-water relationships as recently developed at U. S. Salinity Laboratory. Uptake of water occurs mostly from the upper two-thirds of the rooting depth of crops (the "more-active" part of the root zone). Each irrigation normally will leach this upper soil area and maintain it at relatively low salinity. Salts applied in the irrigation water under reasonable irrigation management concentrate in the soil water in this active root zone to about three times the concentration of the applied irrigation water and the salinity of this root area is representative of the salinity levels to which the plant responds. The salinity of the lower root zone is of less importance as long as plants are reasonably well supplied with moisture in the upper, more active, root zone.

These guidelines represent the 1974 consensus of the UC Committee of Consultants. It is recognized they are not perfect and it is expected they will be modified from time to time as further knowledge and experience dictate.

CROP TOLERANCE TABLES^{1/}

TABLE A-2. FIELD CROPS

Expected Yield Reduction^{2/}
at EC_e or EC_w indicated

Crop	0%			10%			25%			50%			Maximum ECdw ^{6/}
	ECe ^{3/}	ECw ^{4/}	LR ^{5/}	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	
Barley ^{7/} (Hordeum vulgare)	8.0 ^{7/}	5.3	10%	10	6.7	12%	13	8.7	15%	18	12	21%	56
Cotton (Gossypium hirsutum)	7.7	5.1	10%	9.6	6.4	12%	13	8.3	15%	17	12	21%	54
Sugarbeet (Beta vulgaris)	7.0 ^{7/}	4.7	10%	8.7	5.8	12%	11	7.5	16%	15	10	21%	48
Wheat ^{7/ 8/} (Triticum aestivum)	6.0 ^{7/}	4.0	10%	7.4	4.9	12%	9.5	6.4	16%	13	8.7	22%	40
Safflower (Carthamus tinctorius)	5.3	3.5	12%	6.2	4.1	14%	7.6	5.0	17%	9.9	6.6	23%	29
Soybean (Glycine max)	5.0	3.3	17%	5.5	3.7	18%	6.2	4.2	21%	7.5	5.0	25%	20
Sorghum (Sorghum bicolor)	4.0	2.7	7%	5.1	3.4	9%	7.2	4.8	13%	11	7.2	20%	36
Groundnut (Arachis hypogaea)	3.2	2.1	16%	3.5	2.4	18%	4.1	2.7	21%	4.9	3.3	25%	13
Rice (paddy) (Oryza sativa)	3.0	2.0	9%	3.8	2.6	11%	5.1	3.4	15%	7.2	4.8	21%	23
Sesbania (Sesbania macrocarpa)	2.3	1.5	6%	3.7	2.5	8%	5.9	3.9	12%	9.4	6.3	19%	33
Corn (grain) (Zea mays)	1.7	1.1	6%	2.5	1.7	8%	3.8	2.5	13%	5.9	3.9	20%	20
Flax (Linum usitatissimum)	1.7	1.1	6%	2.5	1.7	8%	3.8	2.5	13%	5.9	3.9	20%	20

TABLE A-2. FIELD CROPS (Continued)

Crop	Expected Yield Reduction ^{2/} at EC _e or EC _w indicated												Maximum ECdw ^{6/}
	0%			10%			25%			50%			
	ECe ^{3/}	ECw ^{4/}	LR ^{5/}	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	
Broadbean (Vicia faba)	1.6	1.1	4%	2.6	1.8	7%	4.2	2.0	12%	6.8	4.5	19%	24
Cowpea (Vigna sinensis)	1.3	0.9	5%	2.0	1.3	8%	3.1	2.1	12%	4.9	3.2	19%	17
Beans (field) (Phaseolus vulgaris)	1.0	0.7	5%	1.5	1.0	8%	2.3	1.5	12%	3.6	2.4	19%	13

TABLE A-3. VEGETABLE CROPS

Crop	Expected Yield Reduction ^{2/} at EC _e or EC _w indicated												Maximum EC _{dw}
	0%			10%			25%			50%			
	EC _e	EC _w	LR	EC _e	EC _w	LR	EC _e	EC _w	LR	EC _e	EC _w	LR	
Beets ^{7/} (Beta vulgaris)	4.0	2.7	9%	5.1	3.4	11%	6.8	4.5	15%	9.6	6.4	21%	30
Broccoli (Brassica italica)	2.8	1.9	7%	3.9	2.6	10%	5.5	3.7	14%	8.2	5.5	20%	27
Tomato (Lycopersicon esculentum)	2.5	1.7	7%	3.5	2.3	9%	5.0	3.4	13%	7.6	5.0	20%	25
Cucumber (Cucumis sativus)	2.5	1.7	8%	3.3	2.2	11%	4.4	2.9	15%	6.3	4.2	21%	20
Cantaloupe (Cucumis melo)	2.2	1.5	5%	3.6	2.4	7%	5.7	3.8	12%	9.1	6.1	19%	32
Spinach (Spinacia oleracea)	2.0	1.3	4%	3.3	2.2	7%	5.3	3.5	12%	8.6	5.7	19%	30
Cabbage (Brassica oleracea capitata)	1.8	1.2	5%	2.8	1.9	8%	4.4	2.9	12%	7.0	4.6	19%	24
Potato (Solanum tuberosum)	1.7	1.1	6%	2.5	1.7	8%	3.8	2.5	13%	5.9	3.9	20%	20
Sweet corn (Zea mays)	1.7	1.1	6%	2.5	1.7	8%	3.8	2.5	13%	5.9	3.9	20%	20
Sweet potato (Ipomoea batatas)	1.5	1.0	5%	2.4	1.6	8%	3.8	2.5	12%	6.0	4.0	19%	21
Pepper (Capsicum frutescens)	1.5	1.0	6%	2.2	1.5	9%	3.3	2.2	13%	5.1	3.4	20%	17

TABLE A-3. VEGETABLE CROPS
(Continued)

Crop	Expected Yield Reduction ^{2/} at EC _c or EC _w indicated												Maximum ECdw
	0%			10%			25%			50%			
	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	
Lettuce (Lactuca sativa)	1.3	0.9	5%	2.1	1.4	8%	3.2	2.1	12%	5.2	3.4	19%	18
Radish (Raphanus sativas)	1.2	0.8	4%	2.0	1.3	7%	3.1	2.1	12%	5.0	3.4	19%	18
Onion (Allium copa)	1.2	0.8	5%	1.8	1.2	8%	2.8	1.8	12%	4.3	2.9	19%	15
Carrot (Daucus carota)	1.0	0.7	4%	1.7	1.1	7%	2.8	1.9	12%	4.6	3.1	19%	16
Beans (Phascolus vulgaris)	1.0	0.7	6%	1.5	1.0	8%	2.3	1.5	12%	3.6	2.4	19%	12.5

TABLE A-4. FRUIT CROPS

Crop	Expected Yield Reduction ^{2/} at EC _e or EC _w indicated												Maximum ECdw
	0%			10%			25%			50%			
	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	
Date palm (Phoenix dactylifera)	4.0	2.7	4%	6.8	4.5	7%	10.9	7.3	11%	17.9	12	19%	64
Fig (Ficus carica)													
Olive (Olea europaea)	2.7	1.8	6%	3.8	2.6	9%	5.5	3.7	13%	8.4	5.6	20%	28
Pomegranate (Puncia granatum)													
Grapefruit (Citrus paradisi)	1.8	1.2	8%	2.4	1.6	10%	3.4	2.2	14%	4.9	3.3	21%	16
Orange (Citrus sinensis)	1.7	1.1	7%	2.3	1.6	10%	3.3	2.2	14%	4.8	3.2	20%	16
Lemon (Citrus limonea)	1.7	1.1	7%	2.3	1.6	10%	3.3	2.2	14%	4.8	3.2	20%	16
Apple (Pyrus malus)													
Pear (Pyrus communis)	1.7	1.0	6%	2.3	1.6	10%	3.3	2.2	14%	4.8	3.2	20%	16
Walnut (Juglans regia)	1.7	1.1	7%	2.3	1.6	10%	3.3	2.2	14%	4.8	3.2	20%	16
Peach (Prunus persica)	1.7	1.1	9%	2.2	1.4	11%	2.9	1.9	15%	4.1	2.7	21%	13
Apricot (Prunus armeniaca)	1.6	1.1	9%	2.0	1.3	11%	2.6	1.8	15%	3.7	2.5	20%	12
Grape (Vitis spp.)	1.5	1.0	4%	2.5	1.7	7%	4.1	2.7	11%	6.7	4.5	19%	24
Almond (Prunus amygdalus)	1.5	1.0	7%	2.0	1.4	10%	2.8	1.9	13%	4.1	2.7	20%	14
Plum (Prunus domestica)	1.5	1.0	7%	2.1	1.4	10%	2.9	1.9	14%	4.3	2.8	20%	14

TABLE A-4. FRUIT CROPS
(Continued)

Crop	Expected Yield Reduction ^{2/} at EC _e or EC _w indicated												Maximum ECdw
	0%			10%			25%			50%			
	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	
Blackberry (Rubus spp.)	1.5	1.0	8%	2.0	1.3	11%	2.6	1.8	15%	3.8	2.5	21%	12
Boysenberry (Rubus spp.)	1.5	1.0	8%	2.0	1.3	11%	2.6	1.8	15%	3.8	2.5	21%	12
Avocado (Persea americana)	1.3	0.9	7%	1.8	1.2	10%	2.5	1.7	15%	3.7	2.4	20%	12
Raspberry (Rubus idaeus)	1.0	0.7	6%	1.4	1.0	9%	2.1	1.4	13%	3.2	2.1	19%	11
Strawberry (Fragaria chiloensis)	1.0	0.7	8%	1.3	0.9	10%	1.8	1.2	15%	2.5	1.7	21%	8

TABLE A-5. FORAGE CROPS

Crop	Expected Yield Reduction ^{2/} at EC _e or EC _w indicated												Maximum ECdw
	0%			10%			25%			50%			
	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	
Tall wheat grass (Agropyron elongatum)	7.5	5.0	8%	9.9	6.6	10%	13.3	9.0	14%	19.4	13	21%	63
Wheat grass (fairway) (Agropyron elongatum)	7.5	5.0	11%	9.0	6.0	14%	11	7.4	17%	15	9.8	22%	44
Bermuda grass ^{9/} (Cynodon dactylon)	6.9	4.6	10%	8.5	5.7	13%	10.8	7.2	16%	14.7	9.8	22%	45
Barley (hay) ^{7/} (Hordeum vulgare)	6.0	4.0	10%	7.4	4.9	11%	9.5	6.3	16%	13.0	8.7	22%	40
Perennial rye grass (Lolium perenne)	5.6	3.7	10%	6.9	4.6	12%	8.9	5.9	16%	12.2	8.1	21%	38
Trefoil, birdsfoot ^{10/} narrow leaf (L. corniculatus tenuifolius)	5.0	3.3	11%	6.0	4.0	13%	7.5	5.0	17%	10	6.7	22%	30
Harding grass (Phalaris tuberosa)	4.6	3.1	9%	5.9	3.9	11%	7.9	5.3	15%	11.1	7.4	21%	36
Tall fescue (Festula elatior)	3.9	2.6	6%	5.8	3.9	8%	8.6	5.7	12%	13.3	8.9	19%	46
Crested Wh. grass (Agropyron desertorum)	3.5	2.3	4%	6.0	4.0	7%	9.8	6.5	11%	16	11	19%	57
Vetch (Vicia sativa)	3.0	2.0	8%	3.9	2.6	11%	5.3	3.5	15%	7.6	5.0	21%	24
Sudan grass (Sorghum sudanense)	2.8	1.9	4%	5.1	3.4	7%	8.6	5.7	11%	14.4	9.6	18%	52

TABLE A-5. FORAGE CROPS
(Continued)

Crop	Expected Yield Reduction ^{2/} at EC _e or EC _w indicated												Maximum ECdw
	0%			10%			25%			50%			
	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	ECe	ECw	LR	
Wildrye, beardless (Elymus triticoides)	2.7	1.8	5%	4.4	2.9	7%	6.9	4.6	12%	11.0	7.4	19%	39
Trefoil, big (Lotus uliginosis)	2.3	1.5	10%	2.8	1.9	13%	3.6	2.4	16%	4.9	3.3	22%	15
Alfalfa (Modicago sativa)	2.0	1.3	4%	3.4	2.2	7%	5.4	3.6	12%	8.8	5.9	19%	31
Lovegrass ^{9/} (Eragrostis spp.)	2.0	1.3	5%	3.2	2.1	8%	5.0	3.3	12%	8.0	5.3	19%	28
Corn (forage) (Zea mays)	1.8	1.2	4%	3.2	2.1	7%	5.2	3.5	11%	8.6	5.7	18%	31
Clover, berseem (Trifolium alexandrinum)	1.5	1.0	3%	3.2	2.2	6%	5.9	3.9	10%	10.3	6.8	18%	38
Orchard grass (Dactylis glomerata)	1.5	1.0	3%	3.1	2.1	6%	5.5	3.7	11%	9.6	6.4	18%	35
Meadow foxtail (Alopecarus pratonsis)	1.5	1.0	4%	2.5	1.7	7%	4.1	2.7	11%	6.7	4.5	19%	24
Clover, alsike, ladino, red, strawberry (Trifolium spp.)	1.5	1.0	5.5	2.3	1.6	8%	3.6	2.4	12%	5.7	3.8	19%	20

CROP TOLERANCE TABLES^{1/}

- 1/ Based on data as reported by MAAS and Hoffman (in press); Bernstein, and University of California Committee of Consultants.
- 2/ Expected yield reduction for the particular crop due to indicated salinity of soil or salinity of irrigation water.
- 3/ ECe means electrical conductivity of the saturation extract of the soil reported in millimhos per centimeter at 25° C. Values reported are from MAAS and Hoffman and Bernstein.
- 4/ ECw means electrical conductivity of the irrigation water in millimhos per centimeter at 25° C. This assumes a 15 to 20 percent leaching fraction and an average salinity of soil water equal to about three times that of the irrigation water applied ($EC_{sw} = 3 EC_w$) or about twice that of the soil saturation extract ($EC_{sw} = 2 EC_e$). From the above, $EC_e = 1.5 EC_w$.
- 5/ LR means leaching requirement and is the calculated minimum leaching fraction that can be relied upon to control salts and allow the indicated yield considering tolerance of the particular crop grown and the quality of water used. LR is determined from the equation $LR = EC_w/EC_{dw}$ 6/.
- 6/ Maximum EC_{dw} is the maximum salinity of the percolating water draining from the root zone that can result due to removal of water by the particular crop to meet its water requirement for growth (if all the root zone soil water were at this maximum EC_{dw}, yield reduction would be 100 percent since the crop would be unable to extract water from the very salty soil water). This is the value used as EC_{dw} in the LR calculation ($LR = EC_w/EC_{dw}$). For the given crop and quality of water indicated, application of irrigation water to exactly meet the evapotranspiration demand of crop plus the LR to control salt should result in maximum efficiency of water use. At this efficiency, percolating water draining from the root zone would be minimal as to quantity but at a maximum as to salinity and should approach the maximum EC_{dw} as shown on these crop tolerance tables.
- 7/ Barley, wheat, sugar beets, and several other crops are less tolerant of salts during germination and early seedling growth. For germination of beets, salinity of soil in the seed area should not exceed $EC_e = 3$ mmhos/cm; for barley and wheat, EC_e should not exceed $EC_e = 4$ or 5 mmhos/cm.
- 8/ Tolerance data may not apply to semi-dwarf varieties of wheat. These are often more tolerant.
- 9/ An average of Bermuda grass varieties. Suwanee and Coastal are about 20 percent more tolerant; common and Greenfield are about 20 percent less tolerant.
- 10/ Average of Boer, Wilman, Sand, and Weeping Lovegrass. Lehman appears about 50 percent more tolerant.

EXAMPLE - Use of Crop Tolerance Tables

Crop = Alfalfa

Max. $EC_{dw} = 31$

$$LR\% = \frac{EC_w}{EC_{dw}} \times 100$$

$$\left(\begin{array}{l} \text{Applied water (needed} \\ \text{to supply ET+LR)} = \frac{ET}{1-LR} \end{array} \right)$$

Max. EC_w - From Tables

for 0 yield loss = 1.3 mmho, LR = 4%
10% " " = 2.2 " , LR = 7%
25% " " = 3.6 " , LR = 12%
50% " " = 5.9 " , LR = 19%

**** 0 yield loss expected with $EC_w < 1.3$

$$EC_w = 0.2 \text{ mmho, LR} = \frac{0.2}{31} \times 100 = .6\%$$

$EC_w = 0.5$ " , LR = 1.6%

$EC_w = 0.75$ " , LR = 2.4%

$EC_w = 1.00$ " , LR = 3.2%

$EC_w = 1.30$ " , LR = 4.2%

**** From 0-10% yield loss expected with $EC_w = 1.3-2.2$ mmho

$EC_w = 1.3$ mmho, LR = 4.2%

$EC_w = 1.5$ " , LR = 4.8%

$EC_w = 1.75$ " , LR = 5.6%

$EC_w = 2.0$ " , LR = 6.5%

$EC_w = 2.2$ " , LR = 7.0%

**** From 10-25% yield loss expected with $EC_w = 2.2-3.6$ mmho

$EC_w = 2.2$ mmho, LR = 7.1%

$EC_w = 2.35$ " , LR = 7.6%

$EC_w = 2.50$ " , LR = 8.1%

$EC_w = 2.75$ " , LR = 8.9%

$EC_w = 3.00$ " , LR = 9.7%

$EC_w = 3.30$ " , LR = 10.6%

$EC_w = 3.6$ " , LR = 11.6%

**** From 25-50% yield loss expected with $EC_w = 3.6-5.9$ mmho

$EC_w = 3.6$ mmho, LR = 11.6%

$EC_w = 3.80$ " , LR = 12.3%

$EC_w = 4.00$ " , LR = 12.9%

$EC_w = 4.50$ " , LR = 14.5%

$EC_w = 5.0$ " , LR = 16.1%

$EC_w = 5.3$ " , LR = 17.1%

$EC_w = 5.9$ " , LR = 19.0%

Boron in Irrigation Waters

Boron toxicity in many areas is traceable to use of irrigation waters with boron content in excess of 1 ppm. The University of California Agricultural Extension laboratories are using the following interpretation as regards boron content of irrigation water:

Below 0.5 mg/l - Satisfactory for all crops.

0.5- 1.0 mg/l - Satisfactory for most crops; sensitive crops may show injury (may show leaf injury but yields may not be affected).

1.0- 2.0 mg/l - Satisfactory for semi-tolerant crops. Sensitive crops are usually reduced in yield and vigor.

2.0-10.0 mg/l - Only tolerant crops produce satisfactory yields.

There is no economically feasible method of removing boron from irrigation water. Similarly, there is at present no chemical or soil amendment which can economically be added to the soil to render the boron non-toxic. However, growers in some areas are learning to live with marginal boron and salinity conditions by: (1) maintaining fertility levels slightly above the usual "optimum", and (2) by irrigating a little more frequently than "normal".

TABLE A-6

RELATIVE TOLERANCE OF PLANTS TO BORON

(In each group the plants first named are considered as being more sensitive and the last named more tolerant.)

<u>Sensitive</u>	<u>Semi-Tolerant</u>	<u>Tolerant</u>
0.5 mg/l	1 mg/l	2 mg/l
Lemon	Lima Bean	Carrot
Grapefruit	Sweet Potato	Lettuce
Avocado	Bell Pepper	Cabbage
Orange	Tomato	Turnip
Thornless Blackberry	Pumpkin	Onion
Apricot	Zinnia	Broad Bean
Peach	Oat	Gladiolus
Cherry	Milo	Alfalfa
Persimmon	Corn	Garden Beet
Kadota Fig	Wheat	Mangel
Grape (Sultanina & Malaga)	Barley	Sugar Beet
Apple	Olive	Palm (Phoenix Canariensis)
Pear	Ragged Robin Rose	Date Palm (Phoenix Dactylifera)
Plum	Field Pea	Asparagus
American Elm	Radish	Athel (Tamarix Aphylla)
Navy Bean	Sweet Pea	10 mg/l
Jerusalem Artichoke	Pima Cotton	
Persian (English) Walnut	Acala Cotton	
Black Walnut	Potato	
Pecan	Sunflower (Native)	
1.0 mg/l	2 mg/l	

Adopted from USDA Tech. Bull. No. 448

TABLE A-7

TOLERANCE OF ORNAMENTAL SHRUBS AND GROUND COVERS
TO SALINITY IN IRRIGATION WATER ^{1/}

<u>Sensitive</u> ^{2/} ($EC_w = .75-1.50$) ^{3/}	<u>Moderately Tolerant</u> ($EC_w = 1.50-3.0$)	<u>Tolerant</u> (more than $EC_w = 3.0$)
Star jasmine (<i>Trachelospermum</i> <i>jasminoides</i>)	<i>Pittosporum</i> (<i>P. tobira</i>)	Oleander (<i>Nerium oleander</i>)
Pineapple guava (<i>Feijoa sellowiana</i>)	<i>Viburnum</i> (<i>V. tinus</i> v. <i>robustum</i>)	<i>Pyracantha</i> (<i>P. graeberi</i>)
Burford holly (<i>Ilex cornuta</i> Burford)	Texas privet (<i>Ligustrum lucidum</i>)	Rosemary (<i>Rosmarinus lockwoodi</i>)
Rose (<i>Rosa</i> sp. var. Grenoble on Dr. Huey root)	Lantana (<i>L. camara</i>)	Dracaena (<i>D. endivisa</i>)
Algerian ivy (<i>Hedera canariensis</i>)	Boxwood (<i>Buxus microphylla</i> v. <i>japonica</i>)	Euonymus (<i>E. japonica</i> v. <i>grandiflora</i>)
Hibiscus (<i>H. rosa-sinensis</i> cv. <i>Brilliant</i>)	<i>Xylosma</i> (<i>X. senticosa</i>)	Natal plum (<i>Carissa grandiflora</i>)
Heavenly bamboo (<i>Nandina domestica</i>)	<i>Arborvitae</i> (<i>Thuja orientalis</i>)	Bougainvillea (<i>B. spectabilis</i>)
	<i>Dodonea</i> (<i>D. viscosa</i> v. <i>atropurpurea</i>)	
	Silverberry (<i>Elaeagnus pungens</i>)	
	Spreading juniper (<i>Juniperus chinensis</i>)	
	Bottlebrush (<i>Callistemon viminalis</i>)	

^{1/} Source: L. Bernstein, L. E. Francois, and R. A. Clark. 1972. "Salt Tolerance of Ornamental Shrubs and Ground Covers. J. Amer. Soc. Hort. Sci. 97(4):550-556.

^{2/} Listed in decreasing order of sensitivity. EC_w values shown are associated with generally satisfactory appearance and up to 25% decrease in top growth.

^{3/} EC_w means electrical conductivity of irrigation water (in mmho/cm). Assumptions include the following: $EC_e \times 2 = EC_{sw}$; EC_e = electrical conductivity of soil saturation extract, representative of the more active part of the root zone; EC_{sw} = electrical conductivity of soil water; $EC_w \times 3 = EC_{sw}$, $1/2 EC_{sw} = EC_e$, $sw EC_e = 3/2 EC_w$

TABLE A-8

RECOMMENDED MAXIMUM CONCENTRATIONS OF
TRACE ELEMENTS IN IRRIGATION WATERS ^{1/}

<u>Element</u>	For Waters Used Continuously on All Soil	For Use Up to 20 Years on Fine Textured Soils of pH 6.0 to 8.5
	<u>mg/l</u>	<u>mg/l</u>
Aluminum	5.0	20.0
Arsenic	0.10	2.0
Beryllium	0.10	0.50
Boron	0.75	2.0
Cadmium	0.010	0.050
Chromium	.10	1.0
Cobalt	.050	5.0
Copper	0.20	5.0
Fluoride	1.0	15.0
Iron	5.0	20.0
Lead	5.0	10.0
Lithium	2.5 ^{2/}	2.5 ^{2/}
Manganese	0.20	10.0
Molybdenum	0.010	0.050 ^{3/}
Nickel	0.20	2.0
Selenium	0.020	0.020
Vanadium	0.10	1.0
Zinc	2.0	10.0

^{1/} These levels will normally not adversely affect plants or soils.
No data available for mercury, silver, tin, titanium, tungsten.

^{2/} Recommended maximum concentration for irrigating citrus is 0.075 mg/l.

^{3/} For only acid fine-textured soils or acid soils with relatively high iron oxide contents.

Source: Above data based on Environmental Studies Board, Nat. Acad. of Sci., Nat. Acad. of Eng. "Water Quality Criteria 1972" (U. S. Gov't. Print. Off., Washington, D. C. 20402), p. 339.

TABLE A-9

GUIDE TO THE USE OF SALINE WATERS
FOR LIVESTOCK AND POULTRY ^{1/}

Total Soluble Salt
Content of Waters (mg/l)

Less than 1,000 mg/l (EC less than 1.5) ^{2/}	Relatively low level of salinity. Excellent for all classes of livestock and poultry.
1,000-2,999 (EC = 1.5-5)	Very satisfactory for all classes of livestock and poultry. May cause temporary and mild diarrhea in livestock not accustomed to them or watery droppings in poultry.
3,000-4,999 (EC = 5-8)	Satisfactory for livestock, but may cause temporary diarrhea or be refused at first by animals not accustomed to them. Poor waters for poultry, often causing water feces, increased mortality and decreased growth, especially in turkeys.
5,000-6,999 (EC = 8-11)	Can be used with reasonable safety for dairy and beef cattle, for sheep, swine, and horses. Avoid use for pregnant or lactating animals. Not acceptable for poultry.
7,000-10,000 (EC = 11-16)	Unfit for poultry and probably for swine. Considerable risk in using for pregnant or lactating cows, horses, or sheep, or for the young of these species. In general, use should be avoided although older ruminants, horses, poultry, and swine may subsist on them under certain conditions.
Over 10,000 (EC over 16)	Risks with these highly saline waters are so great that they cannot be recommended for use under any conditions.

^{1/} Environmental Studies Board, Nat. Acad. of Sci, Nat. Acad. of Eng.
 "Water Quality Criteria 1972" (U. S. Gov't. Print. Off., Washington,
 D. C. 20402), p. 308.

^{2/} EC values shown are reported as mmho/cm and are only approximations
 based on rough conversion of given mg/l to EC by $\text{mg/l} \div 640 = \text{EC}$.

TABLE A-10

GUIDELINES TO LEVELS OF TOXIC
SUBSTANCES IN DRINKING WATER FOR LIVESTOCK ^{1/}

<u>Constituent</u>	<u>Upper Limit</u>
Aluminum (Al)	5 mg/l
Arsenic (As)	0.2 mg/l
Beryllium (Be)	No data
Boron (B)	5.0 mg/l
Cadmium (Cd)	.05 mg/l
Chromium (Cr)	1.0 mg/l
Cobalt (Co)	1.0 mg/l
Copper (Cu)	0.5 mg/l
Fluoride (F)	2.0 mg/l
Iron (Fe)	No data
Lead (Pb)	0.1 mg/l ^{2/}
Manganese (Mn)	No data
Mercury (Hg)	.01 mg/l
Molybdenum (Mo)	0.5 mg/l
Nitrate + Nitrite (NO ₃ -N+NO ₂ -N)	100 mg/l
Nitrite (NO ₂ -N)	10 mg/l
Selenium (Se)	0.05 mg/l
Vanadium (Va)	0.10 mg/l
Zinc (Zn)	25 mg/l
Total Dissolved (TDS) Solids	10,000 mg/l ^{3/}

^{1/} Based primarily on Environmental Studies Board, Nat. Acad. of Sci., Nat. Acad. of Eng., "Water Quality Criteria 1972" (U. S. Gov't. Print. Off., Washington, D. C. 20402), p. 309-317.

^{2/} Lead is accumulative and problems may begin at threshold value = 0.05 mg/l.

^{3/} See "Guide to Use of Saline Waters for Livestock and Poultry", included as separate "Guide".

APPENDIX B

WELL DATA

TABLE B-1. WELL DATA

Well No.	Owner	Depth (ft.)	Year Drilled	Log	Well Use	Construction Data
39N/13E/6N1	Don Flournoy	300	1920	no	dom	8" casing
39N/13E/8Q1	D. C. Jeppson	125	1979	yes	dom	6" casing to 23'
39N/13E/17R1	Jim Nelson	310	1979	yes	stock	8" casing to 20'
40N/12E/11F1	Nelson Monroe	800	1915	no	stock	8" casing; artesian
40N/12E/25J1	Pit River Ranch	150		no	dom	
40N/13E/30P1	Charles Williams	205	1970	yes	dom	8" casing
41N/9E/2B1	Wm. Von Borestel	208	1956	yes	dom	6" casing
41N/11E/1E2	Don Crighton	220	1982	yes	dom	6" casing to 20'
41N/11E/2J1	Cal Pines	320		no	dom/irr	8" casing; 2 pumps
41N/11E/1F3	Dennis Huggins	210	1978	yes	dom	6" casing to 40'
41N/11E/3E1	Richard Henry	250		no	dom	cased to 20'
41N/11E/34E3	Gary Riesen	470	old	no	stk/irr	12" casing to 8'
41N/11E/3G2	Orvel Northrup	100	1970	yes	dom	8" casing to 38'
41N/11E/4J1	Winston Campbell	185		yes	dom	
41N/11E/5L3	Diamond C Ranch	100	1971	yes	dom	8" casing to 47'
41N/11E/10G2	Cal. Com. Pines Sv. Dist.	168	1970	yes	mun	
41N/12E/10J3	Floyd McKee	160	1979	no	dom/irr	
41N/12E/10M1	Sid Howard	295	1978	yes	dom	8" casing to 40'
41N/12E/10P1	Sam Peterson	260	1976	no	dom/irr	6" casing to 40'
41N/12E/12L1	Jack Massae	255	1978	yes	dom	12" casing to 40'
41N/12E/15Q1	Fred & John Derner	300	1972	yes	irr	cased to 12'
41N/12E/15R1	John Derner	600	1976	no	irr	open hole

TABLE B-1. WELL DATA (Continued)

Well No.	Owner	Depth (ft.)	Year Drilled	Log	Well Use	Construction Data
41N/12E/22Q1	Lyneta Farms	640	1981	yes	irr	16" casing to 75'
41N/12E/27B1	Lyneta Farms	660	1981	yes	irr	14" casing to 240'/12" cas. 240-360'
41N/13E/18P1	C. E. Massae	280	1946	no	dom	8" casing to 160'
42N/9E/25M1	Wm. Green	505	1969	yes	irr	18" casing to 5'
42N/9E/36A1	Bud Williams	79	1966	yes	dom	8" casing to 47'
42N/10E/22G1	O. W. Porter	160	1968	yes	dom	8" casing to 27'
42N/10E/29H1	J. Harry Manuel	77.2	1982	no	dom	5" casing
42N/10E/36E2	Delas Bone	200	1974	yes	dom	6" casing to 38'
42N/11E/11R1	Victor Cramton	395		no	dom/stk	8" casing
42N/11E/13A3	Norman Van Slyke	200	1974	yes	dom	6" casing
42N/11E/18A1	Sid Collins	395	1980	yes	irr	10" casing to 69'
42N/11E/19A1	Lloyd Royce	359	1980	yes	irr	10" casing to 95'
42N/11E/19E1	Francis Brandon	204	1924	no	dom	8" casing to depth
42N/11E/19H1	Lloyd Roce	390	1980	yes	irr	10" casing to 390'
42N/11E/24A1	Lloyd Goings	114	1941	no	dom/stk	8" casing to 20'
42N/11E/24J2	Gene Brownfield	205	1981	yes	dom	cased to 20'
42N/11E/25D1	Doc Swartes	380		yes	dom	8" casing
42N/11E/33E1	Peter Cary	34		no	dom	5" casing
42N/11E/35A2	Joel Metcalf	350	1982	yes	irr	8" casing to 20'
42N/12E/1A1	Jim Mitchell	150	1980	yes	dom	6" casing to 40'
42N/12E/1B1	Edgar Allen	274	1980	yes	dom	6" casing to 20'
42N/12E/2J3	Gilbert Nolan	195	1981	yes	dom	6" casing

TABLE B-1. WELL DATA (Continued)

Well No.	Owner	Depth (ft.)	Year Drilled	Log	Well Use	Construction Data
42N/12E/2R1	Richard Phillips	280	1979	yes	irr	8" casing to 36'
42N/12E/7M1	John Kelley	260		no	dom	6" casing
42N/12E/8K1	Mr. Huwett	180	1973	yes	dom	8" casing to 40'
42N/12E/10H1	Roy Conners	240		yes	dom	cased to 40'
42N/12E/11J1	City of Alturas	444		no	mun	14" casing
42N/12E/20N1	Dennis Boyle	560	1978	yes	irr	16" casing to 20'
42N/12E/23N1	Modoc County	160	1977	yes	dom	6" casing to 40'
42N/12E/26M1	Robert Wickenden	220	1974	yes	dom	6" casing to 32'
42N/12E/26P1	Glen Jobe	400	1976/77	no	irr	12" casing to 17'
42N/12E/26D1	Norman Van Slyke	285	1978	no	irr	
42N/12E/27R1	Ed Pratt	125	1964	yes	dom	8" casing to 36'
42N/12E/28G1	Gary Segary	240	1981	yes	irr	6" casing to 41'
42N/12E/29C1	Helen R. Perry	225	1978	yes	dom	6" casing to 40'
42N/12E/29R1	BLM	131	1979	yes	dom	6-5/6" casing to 24'6"
42N/13E/31G1	Younger	179		no	dom	
42N/13E/32G1	Steven Baker	80		no	dom	
42N/13E/5G2	Leonard Fitch	700	1977	yes	irr	14" casing to 35'
42N/13E/6N1	Kent Larson	240	1979	yes	irr	8" casing to 40'
42N/13E/6G3	Ron Schluster	105		no	dom	8" casing
42N/13E/6N2	L. E. Harris	260	1974	yes	irr	8" casing to 43'
42N/13E/6P1	Bob Schluter	171.5		no	dom	8" casing
42N/13E/17D1	Stevens Ranch	272		no	dom/stk	4" casing

TABLE B-1. WELL DATA (Continued)

Well No.	Owner	Depth (ft.)	Year Drilled	Log	Well Use	Construction Data
42N/13E/17G1	Warron Schwabel	110	1976	no	dom/irr	
42N/13E/17L2	Earl Sullivan	385	1976	no	irr	16" casing to 18'
42N/13E/18Q1	Dean Neer	660	1979	yes	irr	12" casing
42N/13E/19B1	Dean Neer	200	1981	yes	stock	6" casing to 40'
42N/13E/20B2	Jim Bagwell	271	1979	hes	irr	12" casing to 20'
42N/13E/20E1	W. E. Baker	660	1980	yes	irr	12" casing to 40'
42N/13E/21K2	Tom Rice	265		yes	dom/irr	8" casing to 40'
42N/13E/30C2	Modoc Nat'l. Wldlf. Ref.	250	1980	yes	dom	8" casing to 40'
42N/13E/31H1	John Younger	600	1979	no	stk/irr	16" casing to 40'
42N/13E/31P2	Glen Jobe	400	1973	yes	irr	12" casing / 50-395'
42N/13E/32C2	Ronald Milton	300	1979	yes	irr	12" casing to 15'
42N/13E/33J1	John Weber Ranch	665	1979	yes	irr	12" casing to 18'
43N/13E/14H1	Tom Price (B. Lowes)	250	1976	yes	irr	12" casing to 15'
43N/13E/32Q1	Jack Rice	870	1966	yes	irr	20" and 12" casing

APPENDIX C
MINERAL ANALYSIS OF GROUND WATER

MINERAL ANALYSES OF GROUND WATER

Abbreviations

- TIME - Pacific Standard Time on a 24-hour clock
- TEMP - Water temperature at time of sampling in degrees Fahrenheit (F) and Celsius (C)
- PH - Measure of acidity (<7) or alkalinity (>7) of water
- EC - Electrical conductance in micromhos at 25° Celsius
- TDS - Gravimetric determination of total dissolved solids at 180° C
- SUM - Total dissolved solids by summation of analyzed constituents
- TH - Total hardness
- NCH - Noncarbonate hardness - any excess of total hardness over total alkalinity.
- ASAR - Adjusted sodium adsorption ratio

PERCENT REACTANCE VALUE is determined by dividing the sum of the cations or anions in milliequivalents per liter into each constituent in milliequivalents per liter, arriving at a percentage. For a partial analysis, an approximate value is determined by multiplying the electrical conductance by 0.01 and using that as the cation or anion sum.

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL CONSTITUENTS IN	MILLIGRAMS PER LITER				MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER					REMARKS
			LABORATORY PH	EC		CA	MG	NA	K	PERCENT REACTANCE VALUE			TURB	F SiO2	TDS SUM	TH NCH	SAR ASAR		
										CACO3	SO4	CL						NO3	

	A		SACRAMENTO HB																
	A-23		PITT RIVER HU																
	A-23.E		UPPER PITT RIVER HA																
	A-23.E1		CANBY HSA																
08/25/59	5050				2.2	.1	103	8.4	199	30	6.8	.2	.04	.2		6	18.3		
1445	5050		8.1	464	.11	.01	4.48	.21	3.98	.62	.19	.00		73.0	343	0	10.5		
					2	0	93	4	83	13	4	0							
08/05/58	5050	41N/09E-02A01 M	60.0F		14	8.5	16	12	107	.3	.8	12.0	.00	.1		70	0.8		
	5050		15.5C	8.1	246	.70	.70	.70	.31	2.14	.01	.02	.19	59.0	187	0	1.2		
					29	29	29	13	91	0	1	8							
08/24/82	5050	41N/09E-02B01 M	75.0F	7.5	260	14	8.0	18	12	111	--	1.0	--	--		68	0.9		
1335	5050		23.9C	7.6	238	.70	.66	.78	.31	2.22		.03		--		0	1.3		
					29	27	32	13											
08/05/58	5050	41N/09E-10C02 M	55.0F		25	10	15	5.6	123	5.4	4.7	10.0	.00	.2		105	0.6		
1140	5050		12.6C	8.2	290	1.25	.82	.65	.14	2.46	.11	.13	.16	48.0	197	0	1.0		
					44	29	23	5	86	4	5	6							
08/07/58	5050	41N/09E-13E01 M	64.0F		16	3.6	10	3.1	80	.0	.0	.5	.01	.0		55	0.6		
0940	5050		17.8C	7.9	157	.80	.30	.44	.08	1.60	.00	.00	.01	31.0	112	0	0.7		
					49	19	27	5	99	0	0	1							
08/25/59	5050	41N/10E-02N01 M			6.6	2.8	152	5.0	156	115	62	1.8	.17	.2		28	12.5		
1415	5050		7.8	768	.33	.23	6.61	.13	3.12	2.39	1.75	.03		62.0	501	0	13.8		
					5	3	91	2	43	33	24	0							
08/07/58	5050	41N/10E-02N02 M	65.0F		4.5	1.9	138	5.0	153	94	52	1.5	.21	.1		19	13.8		
0810	5050		18.3C	8.2	689	.22	.16	6.00	.13	3.06	1.96	1.47	.02	57.0	446	0	12.9		
					3	2	92	2	47	30	23	0							
08/24/61	5050				11	1.8	206	5.6	175	168	108	2.0	.15	.2		35	15.2		
1525	5050		8.0	1010	.55	.15	8.96	.14	3.50	3.50	3.05	.03		54.0	661	0	18.5		
					6	2	91	1	35	35	30	0							
08/28/62	5050				13	2.1	258	7.1	194	212	139	2.0	.15	.3		41	17.5		
1100	5050		8.4	1270	.65	.17	11.22	.18	3.68	4.41	3.92	.05		45.0	795	0	23.1		
					5	1	92	1	32	36	32	0							

MINERAL ANALYSES OF GROUND WATER

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DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN					MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				REY
			PH	EC	CA	MG	NA	K	CACD3	PERCENT REACTANCE VALUE			TURB	F SID2	TDS SUM	TH MCH	SAR ASAR	
										SO4	CL	NO3						

	A A-23 A-23.E A-23.E1 41N/10E-11B01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CANBY HSA															
08/07/58	5050	72.0F			21	.4	272	5.1	219	261	101	23.0	1.5	1.0		54	16.1	
0830	5050	22.2C	8.1	1340	1.05	.03	11.83	.13	4.38	5.43	2.85	.37		44.0	860	0	23.9	
					8	0	91	1	34	42	22	3						
	41N/11E-01A01 M																	
08/05/58	5050	64.0F			2.7	.1	44	7.2	87	10	7.9	3.6	.06	.4		7	7.2	
0750	5050	17.8C	8.0	234	.13	.01	1.91	.18	1.74	.21	.22	.06		77.0	205	0	2.4	
					6	0	86	8	78	9	10	3						
	41N/11E-01E02 M																	
09/19/82	5050	68.0F	8.0	160	.0	.0	34	4.9	70	--	3.0	--	--	--		0	0.0	
1300	5050	20.0C	7.7	159	.00	.00	1.48	.13	1.40		.08		--	--		0	0.0	S
					0	0	92	8										
08/25/83	5050	67.0F	7.9	160	--	--	--	--	--	--	--	--	--	--				S
1200	0000	19.4C																
	41N/11E-01F01 M																	
08/07/67	5050	80.5F			1.9	.4	58	5.7	82	29	17	.0	.4	--	222	6	10.3	E
1650	5050	26.9C	8.0	281	.09	.03	2.52	.15	1.64	.60	.48	.00	--	--	162	0	2.3	T
					3	1	90	5	60	22	18	0						
07/24/68	0000	64 F	8.2	295	--	--	--	--	--	--	--	--	--	--				S
1035	5050	18 C																
	41N/11E-01F03 M																	
08/19/82	5050	64.0F	7.4	250	14	3.0	29	10	102	--	5.0	--	.0	.1		48	1.8	
1420	5050	17.8C	7.6	243	.70	.25	1.26	.26	2.04		.14		--	--		0	2.2	S
					28	10	51	11										
08/25/83	5050	62.0F	7.4	295	--	--	--	--	--	--	--	--	--	--				S
1210	0000	16.7C																
09/20/84	5050	61.0F	7.3	290	--	--	--	--	--	--	--	--	--	--				S
0910	0000	16.1C																

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				TDS SUM	TH NCM	SAR ASAR	REM
			PH	EC	CA	MG	NA	K	CACO3	PERCENT SD4	REACTANCE CL	VALUE NO3	TURB	B SID2	F					

	A A-23 A-23.E A-23.E1 41N/11E-02G01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CAMBY HSA																	
09/04/58	5050	62.0F			27	3.0	17	9.1	107	5.8	6.8	5.1	.00	.2			80	0.0		
1040	5050	16.7C	8.1	256	1.35	.25	.74	.23	2.14	.12	.19	.08		69.0			207	0	1.2	
					53		10	29	9		5	8	3							
08/04/58	5050	64.0F			18	1.2	26	14	102	8.9	7.2	3.9	.00	.3			50	1.6		
1010	5050	17.8C	8.0	259	.90	.10	1.13	.36	2.04	.19	.20	.06		70.0			210	0	2.0	
					36		4	45	14		8	8	2							
08/25/59	5050				9.8	.8	45	12	106	23	8.5	1.7	.02	.1			28	3.7		
1540	5050		7.7	297	.49	.07	1.96	.31	2.12	.48	.24	.03		79.0			243	0	3.7	
					17		2	69	11		17	8	1							
07/29/60	5050	0 F			11	.6	40	13	103	18	7.6	1.9	.07	.2			30	3.2		
0915	5050	18 C	8.1	271	.55	.05	1.74	.33	2.06	.37	.21	.03		73.0			227	0	3.3	
					21		2	65	12		14	8	1							
08/24/61	5050				4.0	.0	63	14	106	38	13	.5	.03	.2			10	8.7		
1355	5050		8.2	331	.20	.00	2.74	.36	2.12	.79	.37	.01		71.0			267	0	4.8	
					6		0	83	11		24	11	0							
08/28/62	5050				9.6	1.1	51	13	114	22	8.9	2.0	.1	.2			224	29	4.1	
1035	5050		8.1	305	.48	.09	2.22	.33	2.28	.46	.25	.03		63.0			239	0	4.3	
					15		3	71	11		15	8	1							
09/11/63	5050				15	1.6	31	13	98	13	7.4	3.0	.0	--			221	44	2.0	
1300	5050		7.8	263	.75	.13	1.35	.33	1.96	.27	.21	.05		--			143	0	2.4	
					29		5	53	13		11	8	2							
08/27/64	5050				--	--	57	--	107	--	12	--	--	--			18			
0745	5050		8.3	349			2.48		2.14		.34			--						
							87													
08/12/65	5050				--	--	19	--	--	--	--	--	--	--			61			
	5050						.83							--						
							40													
08/31/66	0000				235	--	--	--	--	--	--	--	--	--						
1250	5050													--						

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM
				CA	MG	NA	K	CACO3	SO4	CL	NO3	TURB	SIO2	B	F				

A A-23 A-23.E A-23.E1 41N/11E-02J01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CANBY HSA				CONTINUED													
08/07/67	5050	62.0F			--	--	39	--	--	--	8.8	--	--	--	37				
1710	5050	16.7C	8.0	277			1.70				.25							S	
							70												
07/24/68	0000	68 F	8.0	255	--	--	--	--	--	--	--	--	--	--					
1045	5050	20 C																	
07/17/69	5050	70.0F	7.9	275	14	4.4	37	--	106	--	8.6	--	--	--	53	2.2			
1410	5050	21.1C	8.1	274	.70	.36	1.61		2.12		.24				0	2.8		S	
					23	12	53												
07/23/70	5050	72 F	8.0	260	--	--	37	--	102	--	7.0	--	--	--	42				
0810	5050	22 C		260			1.61		2.04		.20							S	
							66												
07/28/71	5050	70 F	8.0	238	12	1.4	31	16	103	5.9	4.6	1.9	.0	--	191	37	2.2	E	
0955	5050	21 C	8.2	240	.60	.12	1.35	.41	2.06	.12	.13	.03		--	135	0	2.5	T	
					24	5	54	17	88	5	6	1							
03/24/72	5050	64.0F	7.4	255	--	--	--	--	--	--	--	--	--	--					
1550	5050	17.8C																	
07/31/73	5050	70.0F	7.4	240	--	--	--	--	--	--	--	--	--	--					
1310	0000	21.1C																	
07/16/74	5050	63.0F	7.4	238	--	--	--	--	98	--	8.1	4.2	--	--	64				
1125	5050	17.2C	8.0	241					1.96		.23	.07						S	
09/24/76	5050	63.0F	7.5	220	--	--	--	--	--	--	--	--	--	--					
0925	0000	17.2C																	
08/02/77	5050	69.0F	7.5	255	23	2.0	20	9.0	101	6.0	7.0	5.1	.0	--	204	65	1.1	E	
1425	5050	20.5C	8.5	254	1.15	.16	.87	.23	2.02	.12	.20	.08		--	133	0	1.5	T	
					48	7	36	10	83	5	8	3							
08/22/78	5050	65.0F	7.5	235	--	--	--	--	--	--	--	--	--	--					
0835	0000	18.3C																	

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH MCH	SAR ASAR	REM
				CA	MG	NA	K	CACO3	SO4	CL	NO3	TURB	B SIO2	F					

	A A-23 A-23.E A-23.E1 41N/11E-02J01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CANBY HSA																
07/10/79 0840	5050 0000	68.0F 20.0C	7.5 240	--	--	--	--	--		--	--	--	--	--					
																		S	
03/12/80 0900	5050 0000	65.0F 18.3C	7.6 260	--	--	--	--	--		--	--	--	--	--				S	
08/11/81 0950	5050 0000	69.0F 20.5C	7.7 245	--	--	--	--	--		--	--	--	--	--				S	
08/17/82 0850	5050 5050	66.0F 18.9C	7.6 250 0.2 239	22 1.10 45	3.0 .25 10	19 .83 34	11 .28 11	96 1.92	--	7.0 .20	--	.0 --	--		68 0	1.0 1.4	S		
	41N/11E-03F01 M																		
08/24/82 0930	5050 5050	67.0F 19.4C	7.1 2350 7.8 2260	135 6.74 29	44 3.62 16	279 12.14 52	31 .79 3	180 3.60	--	275 7.76	--	.0 --	.2 --		518 338	5.3 12.4	S		
04/20/83 1130	5050 5050	56.0F 13.3C	7.0 2400 7.9 2200	130 6.49 28	44 3.62 15	288 12.93 53	32 .82 3	175 3.50 14	626 13.03 54	271 7.64 32	.0 .00 0	.1 --	--	1620 1496	506 331	5.6 12.8	E S		
	41N/11E-03F02 M																		
08/24/82 0735	5050 5050	61.0F 16.1C	8.2 375 8.0 378	1.0 .05 1	.0 .00 0	79 3.44 95	6.0 .15 4	118 2.36	--	21 .59	--	--	--		2 0	24.3 2.8	S		
08/25/83 1305	5050 0000	59.0F 15.0C	8.0 390	--	--	--	--	--	--	--	--	--	--						

CONTINUED

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL CONSTITUENTS IN					MILLIGRAMS PER LITER				MILLIGRAMS PER LITER					REMARKS
			LABORATORY PH	EC	CA	MG	NA	K	MILLIEQUIVALENTS PER LITER				B	F	TDS SUM	TH NCH	SAR ASAR		
									PERCENT REACTANCE VALUE	SO4	CL	NO3							

	A		SACRAMENTO HB																
	A-23		PITT RIVER MU																
	A-23.E		UPPER PITT RIVER HA																
	A-23.E1		CANBY HSA																
08/24/82 1000	5050	66.0F	7.4	1500	23	10	272	30	133	--	150	--	.0	.4		98	12.0		
	5050	18.9C	8.0	1510	1.15	.02	11.83	.77	2.66		4.23		--	--		0	18.1	S	
					8	6	81	5											
04/20/83 1145	5050	56.0F	7.3	1525	22	10	261	28	140	353	148	7.5	.1	--	989	96	11.6		
	5050	13.3C	8.1	1470	1.10	.82	11.35	.72	2.80	7.35	4.17	.12	--	--	914	0	17.8	S	
					8	6	81	5	19	51	29	1							
	41N/11E-04J01 M																		
03/04/58 1150	5050	57.0F			120	36	71	19	93	79	140	310	.00	.2		447	1.5		
	5050	13.9C	7.6	1330	5.99	2.96	3.09	.49	1.86	1.64	3.95	5.00	78.0	909	355	3.0			
					48	24	25	4	15	13	32	40							
	41N/11E-05L01 M																		
08/24/82 1030	5050	78.0F	7.3	615	3.0	1.0	122	15	155	--	30	--	.0	.2		12	15.3		
	5050	25.5C	8.1	606	.15	.08	5.31	.38	3.10		.85		--	--		0	11.5	S	
					3	1	90	6											
04/20/83 1200	5050	56.0F	7.1	615	3.0	1.0	121	14	146	97	29	4.4	.1	--	448	12	15.2	E	
	5050	13.3C	8.2	603	.15	.08	5.26	.36	2.92	2.02	.82	.07	--	--	357	0	11.0	T	
					3	1	90	6	50	35	14	1							
	41N/11E-10G01 M																		
08/25/83 1250	5050	65.0F	8.3	455	--	--	--	--	--	--	--	--	--	--				S	
	0000	18.3C												--					
	41N/11E-10G02 M																		
08/24/82 0755	5050	64.0F	8.4	440	1.0	.0	96	7.6	155	--	19	--	.1	--		2	29.5		
	5050	17.8C	8.0	450	.05	.00	4.18	.19	3.10		.54		--	--		0	0.2	S	
					1	0	95	4											
09/20/84 0930	5050	65.0F	8.3	445	--	--	--	--	--	--	--	--	--	--					
	0000	18.3C												--					

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL	CONSTITUENTS IN				MILLIGRAMS PER LITER				MILLIGRAMS PER LITER				TDS SUM	TH NCM	SAR ASAR	REM
			LABORATORY PH	EC		CA	MG	NA	K	MILLIEQUIVALENTS PER LITER				TURB	F SIO2	CL	NO3				
										CACO3	SO4	CL	NO3								

	A		SACRAMENTO HB																		
	A-23		PITT RIVER HU																		
	A-23.E		UPPER PITT RIVER HA																		
	A-23.E1		CANBY HSA																		
08/04/58	5050		78.0F		5.1	.6	25	3.7	69	1.2	1.5	1.1	.01	.1			15	2.8			
1510	5050		25.5C	8.3	145	.25	.05	1.09	.09	1.38	.02	.04	.02	41.0			121	0	1.6		
					17		3	74	6	95	1	3	1								
	41N/11E-26802	M																			
08/04/58	5050		62.0F		9.2	2.7	22	4.5	77	3.0	3.6	3.1	.22	.1			34	1.6			
1710	5050		16.7C	8.1	172	.46	.22	.96	.12	1.54	.06	.10	.05	44.0			138	0	1.6		
					26		13	55	7	88	3	6	3								
	41N/11E-29H01	M																			
08/04/58	5050		65.0F		3.4	.0	60	1.3	128	3.6	2.4	1.0	.00	.7			8	9.2			
1540	5050		18.3C	8.1	260	.17	.00	2.61	.03	2.56	.07	.07	.02	53.0			201	0	5.0		
					6		0	93	1	94	3	3	1								
	41N/11E-29J01	M																			
08/04/58	5050		57.0F		18	3.2	15	4.1	91	.6	1.2	2.1	.00	.2			58	0.9			
1620	5050		13.9C	7.9	184	.90	.26	.65	.10	1.82	.01	.03	.03	62.0			161	0	1.1		
					47		14	34	5	96	1	2	2								
	42N/09E-23K01	M																			
08/05/58	5050		60.0F		12	8.3	32	9.7	122	5.1	8.4	5.4	.05	.2			64	1.7			
1420	5050		15.5C	8.2	292	.60	.68	1.39	.25	2.44	.11	.24	.09	72.0			226	0	2.5		
					21		23	48	9	85	4	8	3								
	42N/09E-25H01	M																			
08/24/82	5050		69.0F	7.7	360	9.0	7.0	53	18	161	--	6.0	--	.0	.2		52	3.2			
1315	5050		20.5C	8.0	357	.45	.58	2.31	.46	3.22		.17		--			0	4.6			
					12		15	61	12												
	42N/09E-26J01	M																			
08/05/58	5050		56.0F		30	19	28	7.8	185	27	6.7	.6	.06	.4			153	1.0			
1340	5050		13.3C	8.2	430	1.50	1.56	1.22	.20	3.70	.56	.19	.01	59.0			289	0	1.9		
					33		35	27	4	83	13	4	0								

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL	CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM
			PH	EC		CA	MG	NA	K	PERCENT REACTANCE VALUE		B	F	TDS	TH						
										CACO3	SD4					CL	NO3				

	A A-23 A-23.E A-23.E1 42N/09E-35R01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CANBY HSA																		
08/05/58	5050	60.0F			5.5	3.8	56	9.8	148	8.9	3.4	3.4	.03	.2			29	4.5			
1240	5050	15.5C	8.2	325	.27	.31	2.44	.25	2.96	.19	.10	.05		65.0			0	5.2			
					8	9	75	8	90	6	3	2									
	42N/09E-36A01 M																				
08/24/82	5050	61.0F	7.2	310	17	9.0	28	12	136	--	6.0	--	--	--			80	1.4			
1255	5050	16.1C	8.1	303	.85	.74	1.22	.31	2.72		.17		--	--			0	2.1			
					27	24	39	10										S			
08/25/83	5050	65.0F	7.3	360	--	--	--	--	--	--	--	--	--	--							
0000		18.3C											--	--				S			
	42N/09E-36L01 M																				
08/05/58	5050	55.0F			34	9.2	31	7.8	169	18	2.9	7.2	.00	.4			123	1.2			
1300	5050	12.8C	8.3	394	1.70	.76	1.35	.20	3.38	.37	.08	.12		58.0			0	2.2			
					42	19	34	5	86	9	2	3									
	42N/10E-13G01 M																				
09/05/58	5050	82.0F			--	--	--	--	--	--	--	--	.26	.3							
0930	5050	27.8C		250										44.0							
	42N/10E-22G01 M																				
08/05/58	5050	59.0F			56	27	29	4.8	227	44	25	9.5	.00	.1			249	0.8			
1010	5050	15.0C	8.6	593	2.79	2.22	1.26	.12	4.54	.92	.71	.15		50.0			24	1.8			
					44	35	20	2	72	15	11	2									
08/24/82	5050	66.0F	7.7	340	23	10	26	7.0	177	--	4.0	--	.0	.2			98	1.1			
1210	5050	18.9C	8.0	315	1.15	.82	1.13	.18	3.54		.11		--	--			0	2.0			
					35	25	34	5										S			
06/15/83	5050	62.0F	7.6	555	44	21	38	6.9	192	42	18	38.0	.1	--			197	1.2			
0840	5050	16.7C	8.4	541	2.20	1.73	1.65	.18	3.84	.87	.51	.61		--			5	2.4			
					38	30	29	3	66	15	9	10						F			
07/19/84	5050	64.0F	7.3	465	--	--	--	--	--	--	--	--	--	--							
1235	0000	17.8C											--	--				S			

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL	CONSTITUENTS IN				MILLIGRAMS PER LITER				MILLIGRAMS PER LITER				SAR	REY
			LABORATORY PH	EC		CA	MG	NA	K	MILLIEQUIVALENTS PER LITER				B	F	TDS	TH		
										PERCENT	REACTANCE	VALUE	NO3						

	A A-23 A-23.E A-23.E1 42N/10E-27E01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CANBY HSA																
08/05/58	5050	63.0F			1.4	.4	111	7.4	206	38	3.4	4.0	.1	.3	351	5	21.6		
	5050	17.2C	8.5	504	.07	.03	4.83	.19	4.12	.79	.10	.06		61.0	350	0	10.9		
					1	1	94	4	81	16	2	1							
08/21/57	5050	198.0F			21	.4	232	6.8	40	297	161	4.4	3.7	1.8	858	54	13.7		
	5050	92.1C	7.4	1240	1.05	.03	10.09	.17	.80	6.18	4.54	.07		99.9	850	14	10.4		
					9	0	89	1	7	53	39	1							
08/05/58	5050	84.0F			.0	.0	63	1.4	120	14	1.9	.6	.07	.2		0	0.0		
1100	5050	28.9C	8.2	269	.00	.00	2.74	.04	2.40	.29	.05	.01		41.0	194	0	0.0		
					0	0	99	1	87	11	2	0							
08/25/59	5050				1.7	.0	60	.8	120	14	2.5	.4	.09	.2		4	13.1		
1400	5050		8.0	271	.08	.00	2.61	.02	2.40	.29	.07	.01		38.0	189	0	2.7		
					3	0	96	1	87	10	3	0							
07/29/60	5050				3.3	.0	58	1.3	117	15	1.9	.4	.10	.2		8	8.9		
0817	5050		8.1	260	.16	.00	2.52	.03	2.34	.31	.05	.01		38.0	188	0	4.5		
					6	0	93	1	86	11	2	0							
08/24/61	5050				3.5	.1	59	1.4	116	15	2.8	.2	.09	.2		9	8.6		
1500	5050		8.2	260	.17	.01	2.57	.04	2.32	.31	.08	.00		37.0	189	0	4.7		
					6	0	92	1	86	11	3	0							
09/11/63	5050				3.0	.0	56	1.6	113	14	2.0	.6	.3	--	195	7	9.2	E	
1330	5050		7.7	275	.15	.00	2.44	.04	2.26	.29	.06	.01		--	145	0	4.0	T	
					6	0	93	2	86	11	2	0							
08/27/64	5050				--	--	57	--	118	--	2.0	--	--	--		7			
0820	5050		8.3	260			2.48		2.36		.06			--				S	
							95												
08/12/65	5050				--	--	58	--	--	--	--	--	--	--		7			
	5050						2.52							--				S	
				255			95												
08/24/82	5050	88.0F	8.4	262	3.0	.0	59	1.3	120	--	2.0	--	.1	.2		8	9.1		
1235	5050	31.1C	8.0	263	.15	.00	2.57	.03	2.40		.06			--		0	4.6	S	
					5	0	93	1											

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				SAR	ASAR	REM
			CA	MG			NA	K	PERCENT REACTANCE VALUE				TURB	B	F	TDS	TH				
									CACO3	SO4	CL	NO3						SUM			

	A		SACRAMENTO HB																		
	A-23		PITT RIVER HU																		
	A-23.E		UPPER PITT RIVER HA																		
	A-23.E1		CANBY HSA																		
	42N/10E-29H01 M																				
08/25/83	5050	80.0F	8.7	260	--	--	--	--	--	--	--	--	--	--							
1515	0000	26.6C																			
	42N/10E-31J01 M																				
07/23/56	5050				12	5.5	60	5.6	164	13	7.8	3.9	.00	.2			52	3.6			
1230	5050		8.0	351	.60	.45	2.61	.14	3.28	.27	.22	.06		64.0	270	0	5.2				
					16	12	69	4	86	7	6	2									
08/05/58	5050	57.0F			8.9	4.1	62	5.8	157	12	5.2	3.5	.12	.4			39	4.3			
1500	5050	13.9C	8.4	352	.44	.34	2.70	.15	3.14	.25	.15	.06		61.0	257	0	5.6				
					12	9	74	4	87	7	4	2									
	42N/10E-36E02 M																				
08/24/82	5050	60.0F	7.3	720	77	14	44	15	223	--	26	--	.1	.2			250	1.2			
1135	5050	15.5C	8.2	695	3.84	1.15	1.91	.38	4.46		.73		--			27	2.7			S	
					53	16	26	5													
	42N/11E-09K01 M																				
08/04/58	5050	90.0F			2.0	.0	48	1.6	88	4.1	13	1.0	.11	.3			5	9.3			
0810	5050	32.2C	9.3	231	.10	.00	2.09	.04	1.76	.09	.37	.02		46.0	169	0	1.7				
					4	0	94	2	79	4	17	1									
08/25/59	5050	92.0F			1.6	.0	48	1.9	85	5.9	13	.4	.1	.3	171	3	12.1			E	
	5050	33.3C	7.9	224	.08	.00	2.09	.05	1.70	.12	.37	.01		49.0	171	0	0.6				
					4	0	94	2	77	5	17	0									
07/29/60	5050	93.0F			1.5	.0	47	1.5	83	5.4	12	.7	.12	.3			3	11.8			
0747	5050	33.9C	8.1	219	.07	.00	2.04	.04	1.66	.11	.34	.01		42.0	160	0	0.7				
					3	0	95	2	78	5	16	0									
	42N/11E-18A01 M																				
09/02/82	5050	75.0F	9.2	270	1.0	.0	57	2.5	100	--	16	--	.2	--			2	17.5			
1300	5050	23.9C	8.8	267	.05	.00	2.48	.06	2.00		.45		--			0	2.9			S	
					2	0	96	2													

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MINERAL ANALYSES OF GROUND WATER

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MINERAL ANALYSES OF GROUND WATER

[illegible]

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				SAR ASAR	REN	
			PH	EC	CA	MG	NA	K	PERCENT REACTANCE VALUE				TURB	B SIO2	F	TDS SUM			TH MCH
									CACO3	SD4	CL	NO3							

	A A-23 A-23.E A-23.E1 42N/11E-19E01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CANBY HSA																
08/12/80 0850	5050 0000	63.0F 17.2C	7.8 485	--	--	--	--	--											
									CONTINUED										
08/11/81 0815	5050 5050	62.0F 16.7C	8.3 460 8.1 455	2.0 .10	.0 .00	--	--	195 3.90	--	6.0 .17	--	--	--			5 0		S	
08/17/82 0800	5050 0000	64.0F 17.8C	8.2 460	--	--	--	--	--	--	--	--	--	--					S	
	42N/11E-19H01 M																		
09/02/82 1215	5050 5050	68.0F 20.0C	8.4 350 8.0 355	6.0 .30 8	1.0 .08 2	71 3.09 86	5.2 .13 4	133 2.66	--	11 .31	--	.0 --	--			19 0	7.1 6.5	S	
	42N/11E-22M01 M																		
08/05/80 0840	5050 5050	62.0F 16.7C	8.2 489	.9 .04 1	.0 .00 0	99 4.31 95	7.7 .20 4	130 2.60 57	36 .75 16	43 1.21 26	.5 .01 0	.05 59.0	.2		324	2 0	30.5 2.6		
	42N/11E-25D01 M																		
08/19/82 0945	5050 5050	71.0F 21.6C	7.3 305 7.8 292	19 .95 33	1.0 .08 3	36 1.57 55	9.9 .25 9	113 2.26	--	12 .34	--	--	--			52 0	2.2 2.8	S	
	42N/11E-25P01 M																		
08/04/80 0900	5050 5050	56.0F 13.3C	8.1 307	22 1.10 36	1.9 .16 5	34 1.48 48	13 .33 11	116 2.32 77	11 .23 8	12 .34 11	8.9 .14 5	.00 69.0	.2		241	63 0	1.9 2.6		
	42N/11E-30F01 M																		
06/15/83 0810	5050 5050	78.0F 25.5C	8.0 725 8.4 715	5.0 .25 4	1.0 .08 1	141 6.13 90	14 .36 5	159 3.18 45	172 3.58 51	7.0 .20 3	4.6 .07 1	.1 --	--		528 440	16 0	15.3 13.4	E	

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				SAR	RF4

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER						
				CA	MG	NA	K	CACO3	SO4	CL	NO3	TURB	SiO2	TDS SUM	TH MCH	SAR ASAR	REY	

	A A-23 A-23.E A-23.E2 39N/12E-02L01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA															
06/02/58 1040	5050 5000	64.0F 17.8C	7.9 139	10 .50 27	5.0 .41 22	18 .78 42	6.2 .16 9	79 1.58 88	5.4 .11 6	2.5 .07 4	2.1 .03 2	.0 45.0	.1	142	45 0	1.2 1.3	C	
06/02/58 1435	5050 9551	59.0F 15.0C	8.3 345	37 1.85 43	8.8 .72 17	40 1.74 40	1.4 .04 1	182 3.64 75	31 .65 13	13 .37 8	11.0 .18 4	.0 52.0	.2	303	130 0	1.5 2.9	C S	
06/02/58 1300	5050 9551	70.0F 21.1C	7.8 125	6.1 .30 19	1.2 .10 6	24 1.04 67	4.8 .12 8	66 1.32 82	7.7 .16 10	3.5 .10 6	2.0 .03 2	.03 58.0	.2	147	20 0	2.3 1.6	C	
08/25/59 1415	5050 5050	70.0F 21.1C	7.5 169	5.7 .28 18	1.2 .10 6	25 1.09 68	5.1 .13 8	69 1.38 86	4.9 .10 6	3.8 .11 7	1.0 .02 1	.04 63.0	.1	151	19 0	2.5 1.7		
07/29/60 0850	5050 5050	69.0F 20.5C	7.8 175	6.6 .33 19	1.6 .13 7	27 1.17 66	4.9 .13 7	77 1.54 87	4.6 .10 6	3.8 .11 6	1.4 .02 1	.07 56.0	.2	152	23 0	2.4 2.0		
08/24/61 1220	5050 5050		8.0 194	8.2 .41 21	1.8 .15 8	28 1.22 64	5.2 .13 7	87 1.74 92	2.0 .04 2	3.3 .09 5	1.5 .02 1	.08 55.0	.1	157	28 0	2.3 2.2		
08/28/62 0820	5050 5050		8.0 170	7.2 .36 18	2.3 .19 10	30 1.31 66	4.8 .12 6	81 1.62 87	3.4 .07 4	5.3 .15 8	1.0 .02 1	.1 50.0	.1	136 153	28 0	2.5 2.2	E	
09/12/63 0920	5050 5050		7.7 203	8.4 .42 20	1.9 .16 8	31 1.35 65	5.9 .15 7	89 1.78 88	4.6 .10 5	4.1 .12 6	1.2 .02 1	.0 --	--	156 110	29 0	2.5 2.4	E T	
08/27/64 1015	5050 5050		8.1 189	-- 1.17 68	-- 1.17 68	27 1.17 68	-- 1.17 68	85 1.70	-- 1.10	3.7 .10	-- --	-- --	--		27		S	
08/12/65	5050 5050		165	-- 1.13 71	-- 1.13 71	26 1.13 71	-- 1.13 71	--	--	--	--	--	--		23		S	

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL	CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				SAR ASAR	REM	
			PH	EC		CA	MG	NA	K	PERCENT CACO3	REACTANCE SO4	CL	NO3	TURB	B SI02	TDS SUM	TH NCH			

	A A-23 A-23.E A-23.E2 39N/13E-06N01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				CONTINUED													
08/29/66	5050				--	--	34	--	--								48			
1250	5050		8.1	227			1.48				4.7	--	--	--						
							61				.13	--	--							
08/07/67	5050	70.0F			--	--	28	--	75		4.1	--	--	--			23			
1520	5050	21.1C	8.1	177			1.22		1.50		.12	--	--	--						
							73													
07/24/68	5050	68 F	7.5	215	10	3.4	32	--	98		4.0	--	--	--			39	2.2		
0800	5050	20 C	7.9	223	.50	.28	1.39		1.96		.11	--	--	--			0	2.5		
					20	11	57													
07/14/69	5050	70.0F	7.5	219	--	--	28	--	--		--	--	--	--			33			
1500	5050	21.1C		212			1.22					--	--	--						
							65													
07/22/70	5050	68 F	7.5	255	12	4.9	35	6.5	120	4.9	3.8	1.8	.0	--	185	50	2.2	E		
1330	5050	20 C	7.8	249	.60	.40	1.52	.17	2.40	.10	.11	.03	--		141	0	2.8	T		
					22	15	57	6	91	4	4	1								
07/27/71	5050	77 F	7.4	255	--	--	--	--	--	--	--	--	--	--						
1350	0000	25 C																		
08/24/72	5050	69.0F	7.4	280	--	--	--	--	125	--	4.8	--	--	--			55			
1210	5050	20.5C	8.1	265					2.50		.14	--	--	--						
08/02/73	5050	77.0F	7.7	265	--	--	--	--	--	--	--	--	--	--						
0940	0000	25.0C																		
08/14/75	5050	67.0F	7.2	225	--	--	--	--	97	--	4.8	2.6	--	--			40			
1430	5050	19.4C	8.1	217					1.94		.14	.04	--	--						
08/26/76	5050	68.0F	7.6	175	--	--	27	--	76	--	4.7	--	--	--			24			
1240	5050	20.0C	8.2	173			1.17		1.52		.13	--	--	--						
							71													
08/03/77	5050	72.0F	7.4	195	--	--	--	--	--	--	--	--	--	--						
0855	0000	22.2C																		

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER							RE4	
				CA	MG	NA	K	CACO3	PERCENT REACTANCE VALUE	SO4	CL	NO3	TURB	F SIO2	TDS SUM	TH NCH	SAR ASAR			

A A-23 A-23.E A-23.E2 39N/13E-06N01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				CONTINUED														
07/12/79 1350	5050	68.0F	7.2	340	23	9.0	38	7.3	161	12	5.0	4.4	.0	--	249	94	1.7	E		
	5050	20.0C	8.4	345	1.15	.74	1.65	.19	3.22	.25	.14	.07	--	--	195	0	2.9	T		
					31	20	44	5	88	7	4	2								
08/13/80 1245	5050	71.0F	7.2	300	--	--	--	--	--	--	--	--	--	--						
	0000	21.6C																		
08/13/81 1400	5050	70.0F	7.4	240	--	--	--	--	--	--	--	--	--	--						
	0000	21.1C																		
08/19/82 1410	5050	67.0F	7.3	250	14	5.0	33	6.3	115	--	5.0	--	.0	--		56	1.9			
	5050	19.4C	8.3	261	.70	.41	1.44	.16	2.30		.14		--	--		0	2.6		S	
					26	15	53	6												
08/25/83 0830	5050	67.0F	7.3	215	--	--	--	--	--	--	--	--	--	--						
	0000	19.4C																		
39N/13E-07N01 M																				
06/02/58 0950	5050	54.0F			67	34	28	4.4	357	5.8	3.5	2.7	.0	.2		308	0.7			
	9551	12.2C	8.3	490	3.34	2.80	1.22	.11	7.13	.12	.10	.04		42.0	401	0	1.7	C		
					45	37	16	1	96	2	1	1								
39N/13E-08K01 M																				
11/18/55 1700	5050				20	6.6	29	7.9	134	7.0	6.0	1.5	.00	.1		77	1.4			
	5050		7.9	288	1.00	.54	1.26	.20	2.68	.15	.17	.02		47.0	205	0	2.2			
					33	18	42	7	89	5	6	1								
06/02/58 1235	5050	59.0F			20	8.3	27	8.2	133	7.9	4.5	2.4	.0	.1		84	1.3			
	9551	15.0C	8.1	220	1.00	.69	1.17	.21	2.66	.16	.13	.04		44.0	202	0	2.0	C		
					33	22	38	7	89	5	4	1								

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				REMARKS	
			PH	EC	CA	MG	NA	K	PERCENT CACD3	REACTANCE SO4	VALUE CL	NO3	TURB	SIO2	TDS SUM	TH NCH		SAR ASAR

A		SACRAMENTO HB																
A-23		PITT RIVER HU																
A-23.E		UPPER PITT RIVER HA																
A-23.E2		ALTURAS HSA																
08/23/82	5050	68.0F	7.2	445	36	14	35	6.8	180	--	14	--	.0	.1		148	1.3	
1600	5050	20.0C	8.1	437	1.80	1.15	1.52	.17	3.60		.39		--	--		0	2.4	S
					39	25	33	4										
08/25/83	5050	65.0F	7.1	460	--	--	--	--	--	--	--	--	--	--				S
0800	0000	18.3C																
09/19/84	5050	64.0F	7.1	470	--	--	--	--	--	--	--	--	--	--				S
1040	0000	17.8C																
39N/13E-09Q01 M																		
06/02/58	5050	56.0F			19	9.5	12	5.4	109	7.7	3.0	2.4	.03	.1		86	0.6	
1350	9551	13.3C	7.8	180	.95	.78	.52	.14	2.18	.16	.08	.04		64.0	188	0	0.9	C
					40	33	22	6	89	7	3	2						
39N/13E-17R01 M																		
08/23/82	5050	74.0F	7.3	162	11	5.0	12	6.0	74	--	3.0	--	--	--		48	0.8	
1620	5050	23.3C	7.4	160	.55	.41	.52	.15	1.48		.08		--	--	0	0.8	S	
					34	25	32	9										
08/25/83	5050	60.0F	7.2	162	--	--	--	--	--	--	--	--	--	--				S
0815	0000	15.5C																
39N/13E-18A01 M																		
06/02/58	5050	58.0F			51	23	27	6.4	242	14	7.5	15.0	.0	.2	333	220	0.8	E
	5050	14.4C	8.3	400	2.54	1.89	1.17	.16	4.84	.29	.21	.24		44.0	333	0	1.7	C
					44	33	20	3	87	5	4	4						
40N/12E-11F01 M																		
11/21/55	5050	62.0F			8.8	1.7	21	5.7	67	7.0	4.0	1.5	.09	.1		29	1.7	
1045	5000	16.7C	7.6	162	.44	.14	.91	.15	1.34	.15	.11	.02		71.0	161	0	1.4	
					27	9	55	9	83	9	7	1						
06/03/58	5050	66.0F			9.2	1.2	18	5.8	67	4.8	2.0	1.3	.0	.2		28	1.5	
0845	9551	18.9C	8.0	120	.46	.10	.78	.15	1.34	.10	.06	.02		64.0	146	0	1.2	C
					31	7	52	10	88	7	4	1						
08/25/59	5050	0 F			8.1	1.7	21	5.9	67	4.9	4.0	1.9	.01	.2		27	1.8	
1640	5050	18 C	7.5	171	.40	.14	.91	.15	1.34	.10	.11	.03		78.0	166	0	1.4	
					25	9	57	9	85	6	7	2						

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				SAR	REMARKS

A A-23 A-23.E A-23.E2 40N/12E-11F01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				CONTINUED											
07/29/60	5050	69.0F		8.3	1.8	22	5.9	68	6.1	3.8	1.8	.10	.1	28	1.8		
0930	5050	20.5C	8.0 162	.41 25	.15 9	.96 57	.15 9	1.36 83	.13 8	.11 7	.03 2		71.0	162	0	1.5	
08/24/61	5050	71.0F		8.0	2.2	18	5.3	66	4.1	3.3	2.0	.07	.2	29	1.5		
1125	5050	21.6C	8.0 162	.40 27	.18 12	.78 52	.14 9	1.32 86	.09 6	.09 6	.03 2		72.0	155	0	1.2	
09/12/63	5050			4.3	4.2	21	5.7	66	4.9	4.2	1.8	.0	--	153	28	1.7	
0845	5050		7.6 163	.21 13	.35 22	.91 56	.15 9	1.32 84	.10 6	.12 8	.03 2		--	86	0	1.4	
09/27/64	5050			--	--	21	--	70	--	3.2	--		--		29		
0940	5050		8.1 173			.91 61		1.40		.09			--				
08/12/65	5050	72 F		--	--	22	--	--	--	--	--		--		29		
	5050	22 C	164			.96 62							--				
08/29/66	0000		164	--	--	--	--	--	--	--	--		--				
	0000												--				
08/07/67	5050			--	--	21	--	--	--	3.8	--		--		74		
1445	5050		8.2 162			.91 38				.11			--				
07/24/68	5050	69 F	7.9 165	8.2	2.1	22	--	68	--	3.7	--		--		29	1.8	
0900	5050	21 C	8.0 168	.41 24	.17 10	.96 56		1.36		.10			--		0	1.5	
07/14/69	0000	76.0F	8.3 160	--	--	--	--	--	--	--	--		--				
1645	5050	24.4C											--				
07/22/70	5050	74 F	8.3 161	--	--	--	--	--	--	--	--	.0	.2		32		
1410	5050	23 C	162										--				
07/27/71	5050	77 F	8.0 162	--	--	--	--	--	--	--	--		--				
1430	0000	25 C											--				

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM
				CA	MG	NA	K	CACO3	SO4	CL	NO3	TURB	SiO2						

	A A-23 A-23.E A-23.E2 40N/12E-11F01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																
08/24/72	5050	72.0F	7.9	170	--	--	--	--	--	--	--	--	--						
1245	0000	22.2C																	
08/02/73	5050	70.0F	8.1	160	--	--	--	--	--	--	--	--	--						
0905	0000	21.1C																	
07/18/74	5050	70.0F	8.0	160	--	--	--	--	--	--	--	--	--						
0850	0000	21.1C																	
08/14/75	5050	68.0F	8.0	170	--	--	--	--	66	--	4.4	3.4	--	--			28		
1355	5050	20.0C	8.0	161					1.32		.12	.05							S
08/26/76	5050	67.0F	8.1	160	--	--	--	--	--	--	--	--	--	--					
1200	0000	19.4C																	S
08/03/77	5050	69.0F	7.9	165	7.9	1.7	21	5.9	64	5.8	4.7	3.0	.0	--		154	27	1.8	E
0815	5050	20.5C	8.2	165	.39	.14	.91	.15	1.28	.12	.13	.05		--		88	0	1.4	T
					25	9	57	9	81	8	8	3							
08/24/78	5050	63.0F	8.0	170	--	--	--	--	--	--	--	--	--	--					
1245	0000	17.2C																	
07/12/79	5050	66.0F	8.0	165	--	--	--	--	--	--	--	--	--	--					
1310	0000	18.9C																	
08/13/80	5050	64.0F	8.1	170	--	--	--	--	--	--	--	--	--	--					
1325	0000	17.8C																	
08/13/81	5050	67.0F	8.7	165	--	--	--	--	--	--	--	--	--	--					
1300	0000	19.4C																	
08/19/82	5050	68.0F	8.4	160	8.0	2.0	21	5.8	66	--	3.0	--	--	--			28	1.7	
1310	5050	20.0C	8.3	161	.40	.16	.91	.15	1.32		.08			--			0	1.4	S
					25	10	56	9											

CONTINUED

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MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				SAR ASAR	REM

A A-23 A-23.E A-23.E2 40N/12E-11F01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				CONTINUED											
08/25/83 0910	5050 0000	68.0F 20.0C	7.9 160	--	--	--	--	--	--	--	--	--	--	--			
40N/12E-25J01 M																	
11/18/55 1600	5050 5000		8.0 443	19 .95 19	8.9 .73 15	71 3.09 62	9.8 .25 5	232 4.64 93	9.0 .19 4	5.0 .14 3	1.5 .02 0	.16 71.0	.1	334	84 0	3.4 6.0	
06/03/58 0745	5050 9551	58.0F 14.4C	8.3 345	23 1.15 23	8.1 .67 13	66 2.87 58	11 .28 6	233 4.66 95	5.9 .12 2	1.8 .05 1	3.0 .05 1	.0 64.0	.3	323	91 0	3.0 5.5	C
08/28/59 1515	5050 5050	64.0F 17.8C	8.1 478	22 1.10 21	10 .82 16	70 3.05 58	10 .26 5	254 5.07 95	7.6 .16 3	2.8 .08 1	1.9 .03 1	.11 77.0	.2	354	96 0	3.1 5.8	
07/29/60 0915	5050 5050	69.0F 20.5C	8.4 457	20 1.00 20	9.0 .74 15	69 3.00 60	10 .26 5	229 4.58 93	9.7 .20 4	4.8 .14 3	1.7 .03 1	.13 71.0	.2	333	87 0	3.2 5.8	
08/24/61 1145	5050 5050	66.0F 18.9C	8.5 464	21 1.05 20	8.9 .73 14	72 3.13 60	11 .28 5	240 4.80 95	7.1 .15 3	3.0 .08 2	2.6 .04 1	.14 70.0	.2	340	89 0	3.3 6.0	
08/28/62 0800	5050 5050		8.4 420	17 .85 18	8.1 .67 14	69 3.00 63	9.5 .24 5	212 4.24 87	12 .25 5	14 .39 8	1.0 .02 0	.2 63.0	.1	312 321	75 0	3.5 5.9	E
09/12/63 0900	5050 5050		8.1 429	17 .85 19	6.7 .55 12	64 2.78 63	9.9 .25 6	187 3.74 87	16 .33 8	8.1 .23 5	.9 .01 0	.2 --	--	305 235	70 0	3.3 5.4	E T
08/27/64 1005	5050 5050		8.2 460	-- -- 64	-- -- 2.87	66 -- 64	-- -- 6	212 4.24	-- -- --	6.1 .17	-- --	-- --	-- --		81		S
08/12/65	5050 5050			-- -- 62	-- -- 3.13	72 -- 62	-- -- 6	-- --	-- --	-- --	-- --	-- --	-- --		95		S

CONTINUED

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MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER							

				CA	MG	NA	K	CACO3	SO4	CL	NO3	TURB	B SiO2	FDS SUM	TH MCH	SAR ASAR	REM		
		A A-23 A-23.E A-23.E2 40N/12E-25J01 M	SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA	CONTINUED															
08/29/66	0000 0000		413	--	--	--	--	--	--	--	--	--	--						
08/07/67	5050 1500		8.4 527	--	--	74 3.22 59	--	--	--	5.8 .16	--	--	.2 --		113		S		
07/24/68	5050 0845	64 F 18 C	7.3 510 8.2 526	24 1.20 22	10 .82 15	72 3.13 58	10 .26 5	255 5.09 93	9.4 .20 4	5.2 .15 3	2.0 .03 1	.0 --	--	348 285	102 0	3.1 5.9			
07/14/69	0000 1610	64.0F 17.8C	7.4 510	--	--	--	--	--	--	--	--	--	--						
07/22/70	0000 1345	61 F 16 C	7.3 500	--	--	--	--	--	--	--	--	--	--						
07/27/71	5050 1415	64 F 18 C	7.3 390 8.3 373	12 .60 15	5.1 .42 11	63 2.74 69	9.2 .24 6	153 3.06 80	22 .46 12	11 .31 8	.8 .01 0	.0 --	--	285 215	51 0	3.8 5.4	E T		
08/24/72	5050 1230	63.0F 17.2C	7.3 540 8.0 532	--	--	74 3.22 58	--	275 5.49	--	7.0 .20	--	--	--		117		S		
08/02/73	5050 0925	64.0F 17.8C	7.3 520	--	--	--	--	--	--	--	--	--	--				S		
07/18/74	5050 0910	66.0F 18.9C	7.3 480	--	--	--	--	--	--	--	--	--	--				S		
08/14/75	5050 1410	65.0F 18.3C	7.3 520	--	--	--	--	--	--	--	--	--	--				S		
08/26/76	5050 1220	59.0F 15.0C	7.3 520	--	--	--	--	--	--	--	--	--	--				S		

CONTINUED

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM
			PH	EC	CA	MG	NA	K	PERCENT REACTANCE VALUE				B TURB	F SiO2						
									CAC03	SO4	CL	NO3								

	A A-23 A-23.E A-23.E2 40N/12E-25J01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				CONTINUED													
08/03/77	5050	69.0F	7.3	460	22	9.6	72	8.4	249	12	6.7	1.0	.0	--	347	96	3.2			
0835	5050	20.5C	8.7	497	1.10	.79	3.13	.21	4.98	.25	.19	.02	--	--	281	0	6.0			
					21	15	60	4	92	5	3	0						S		
08/24/78	5050	58.0F	7.3	460	--	--	--	--	--	--	--	--	--	--						
1300	0000	14.4C																		
07/12/79	5050	60.0F	7.4	470	--	--	--	--	--	--	--	--	--	--						
1330	0000	15.5C																		
08/13/80	5050	61.0F	7.3	510	22	9.0	--	11	238	--	7.0	--	--	--		92				
1300	5050	16.1C	8.6	481	1.10	.74		.28	4.76		.20		--	--		0		S		
08/13/81	5050	66.0F	7.4	520	--	--	--	--	--	--	--	--	--	--						
1345	0000	18.9C																S		
09/19/82	5050	64.0F	7.3	510	--	--	--	--	--	--	--	--	--	--						
1330	0000	17.8C																S		
08/25/83	5050	61.0F	7.4	520	--	--	--	--	--	--	--	--	--	--						
0855	0000	16.1C																S		
	40N/12E-26A01 M																			
06/03/58	5050	56.0F			17	7.5	29	8.2	148	1.6	1.2	--	.0	.2		73	1.5			
0805	9551	13.3C	8.3	210	.85	.62	1.26	.21	2.96	.03	.03			52.0	206	0	2.3	S		
					29	21	43	7												
	40N/13E-30P01 M																			
08/23/82	5050	69.0F	8.0	275	7.0	.0	45	6.3	53	--	18	--	--	--		18	4.6			
1640	5050	20.5C	7.4	274	.35	.00	1.96	.16	1.06		.51		--	--		0	2.4	S		
					14	0	79	6												
08/25/83	5050	61.0F	7.9	275	--	--	--	--	--	--	--	--	--	--						
0845	0000	16.1C																		

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN	MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				MILLIGRAMS PER LITER				TH	SAR	REM
				CA	MG	NA	K	PERCENT CACO3	REACTANCE SO4	VALUE CL	NO3	TURB	F SIO2	TDS SUM	NCH	ASAR			

	A A-23 A-23.E A-23.E2 40N/13E-30P01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																
09/19/84	5050	72.0F	7.9	275	--	--	--	--	--	CONTINUED	--	--	--	--					
1115	0000	22.2C															S		
06/02/58	5050	40N/13E-31E01 M																	
1900	5000	110.0F			6.0	.1	40	4.0	65	27	11	--	.14	.4		10	5.5		
		43.3C	8.3	180	.30	.01	1.74	.10	1.30	.56	.31			56.0	184	0	2.0		
					14	0	81	5									S		
06/02/58	5050	110.0F			5.0	.4	46	3.7	71	27	12	--	.2	.3		14	5.4		
1515	5000	43.3C	8.3	240	.25	.03	2.00	.09	1.42	.56	.34			58.0	196	0	2.9		
					11	1	84	4									S		
06/03/58	5050	41N/12E-02N01 M																	
0940	9551	57.0F			47	12	29	11	112	30	31	80.0	.0	.1		167	1.0		
		13.9C	8.1	390	2.35	.99	1.26	.28	2.24	.62	.87	1.29		64.0	371	55	1.7		
					48	20	26	6	45	12	17	26					C		
11/18/55	5000	41N/12E-10J01 M																	
1330	5000				25	8.2	30	7.2	115	20	17	12.0	.04	.4		96	1.3		
			7.5	334	1.25	.67	1.31	.18	2.30	.42	.48	.19		70.0	258	0	2.1		
					37	20	38	5	68	12	14	6							
09/18/82	5050	41N/12E-10J03 M																	
1450	5050	67.0F	7.2	380	25	8.0	37	9.7	130	--	17	--	--	--		96	1.6		
		19.4C	7.9	375	1.25	.66	1.61	.25	2.60		.48		--	--		0	2.6		
					33	18	43	7									S		
08/24/83	5050	67.0F	7.4	225	--	--	--	--	--	--	--	--	--	--					
1440	0000	19.4C															S		
08/18/82	5050	41N/12E-10M01 M																	
1425	0000	71.0F	7.3	230	--	--	--	--	--	--	--	--	--	--			S		
		21.6C																	
08/24/83	5050	67.0F	7.3	205	15	4.0	19	6.8	91	5.0	3.0	4.2	.0	--	146	54	1.1		
1510	5050	19.4C	7.8	204	.75	.33	.83	.17	1.82	.10	.08	.07	--	--	112	0	1.4		
					36	16	40	8	88	5	4	3					T		

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REH
			CA	MG			NA	K	CAC03	SO4	CL	NO3	TURB	SiO2	F	B						

	A		SACRAMENTO HB																			
	A-23		PITT RIVER HU																			
	A-23.E		UPPER PITT RIVER HA																			
	A-23.E2		ALTURAS MSA																			
08/18/82	5050		82.0F	7.3	220	16	5.0	23	8.1	111	--	4.0	--	--	--		60	1.3				
1440	5050		27.8C	7.7	227	.80	.41	1.00	.21	2.22		.11		--	--		0	1.8				
						33	17	41	9									S				
08/24/83	5050		64.0F	7.4	385	34	13	--	--	177	--	9.0	3.3	--	--		139					
1450	5050		17.8C	8.1	381	1.70	1.07			3.54		.25	.05	--	--		0					
																		S				
		41N/12E-12L01 M																				
08/18/82	5050		67.0F	7.6	850	50	9.0	107	16	142	--	104	--	--	--		162	3.7				
1240	5050		19.4C	8.0	857	2.50	.74	4.65	.41	2.84		2.93		--	--		20	6.6				
						30	9	56	5									S				
04/20/83	5050		60.0F	7.6	875	48	8.0	107	16	116		151	98	2.6	.9	--	589	153	3.8			
1050	5050		15.5C	8.1	850	2.40	.66	4.65	.41	2.32		3.14	2.76	.04	--	--	501	37	6.4			
						30	8	57	5	28		38	33	0								
09/20/84	5050		65.0F	7.4	1100	77	13	121	--	109	--	178	--	--	--		246	3.4				
0800	5050		18.3C	8.0	1110	3.84	1.07	5.26		2.18		5.02		--	--		137	6.2				
						38	11	52										S				
		41N/12E-15H01 M																				
06/03/58	5050		64.0F			13	1.3	24	7.6	84		7.4	5.8	2.7	.05	.3	38	1.7				
0910	9551		17.8C	8.1	160	.65	.11	1.04	.19	1.68		.15	.16	.04		74.0	186	0	1.8			
						33	6	52	10	83		7	8	2					C			
08/25/58	5050		74.0F			13	1.3	29	7.4	92		7.4	6.6	3.3	.11	.2	38	2.0				
1605	5050		23.3C	7.7	228	.65	.11	1.26	.19	1.84		.15	.19	.05		89.0	212	0	2.2			
						29	5	57	9	83		7	9	2								
07/29/60	5050		74.0F			12	1.9	29	7.1	89		6.7	6.3	3.6	.12	.2	38	2.0				
1000	5050		23.3C	8.0	220	.60	.16	1.26	.18	1.78		.14	.18	.06		82.0	202	0	2.2			
						27	7	57	8	82		6	8	3								
08/24/61	5050					13	1.3	27	7.0	89		6.6	6.0	3.3	.15	.2	38	1.9				
1015	5050			8.0	222	.65	.11	1.17	.18	1.78		.14	.17	.05		80.0	198	0	2.1			
						31	5	55	9	83		7	8	2								
07/12/63	5050					12	1.2	29	8.0	87		7.4	7.4	1.1	.2	--	188	35	2.1	E		
0830	5050			7.7	216	.60	.10	1.26	.20	1.74		.15	.21	.02	--	--	118	0	2.2	T		
						28	5	58	9	82		7	10	1								

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM	
					CA	MG	NA	K	CACO3	PERCENT SD4	REACTANCE CL	VALUE NO3	TURB	B	F	SIO2					

		A	SACRAMENTO HB																		
		A-23	PITT RIVER HU																		
		A-23.E	UPPER PITT RIVER HA																		
		A-23.E2	ALTURAS HSA																		
		41N/12E-15H01 M									CONTINUED										
08/27/64	5050				--	--	27	--	90		--	6.5	--	--			39				
0910	5050		8.1	219			1.17		1.80			.18		--					S		
							60														
08/12/65	5050				--	--	29	--	--		--	--	--	--			38				
	5050			218			1.26							--					S		
							62														
09/21/66	0000			220	--	--	--	--	--		--	--	--	--							
	0000													--							
08/07/67	5050	71.5F			--	--	30	--	--		--	6.7	--	--			39				
1430	5050	21.9C	8.2	224			1.31					.19		--					S		
							63														
07/27/71	5050	70 F	7.3	270	17	2.3	32	7.8	103		6.6	8.1	13.0	.0	--	228	52	1.9	E		
1530	5050	21 C	8.1	263	.85	.19	1.39	.20	2.06		.14	.23	.21	--	149	0	2.4	T			
					32	7	53	8	78		5	9	8								
		41N/12E-15Q01 M																			
03/18/82	5050	77.0F	7.7	215	11	2.0	28	7.9	89		--	6.0	--	.1	.4		36	2.0			
1405	5050	25.0C	7.7	213	.55	.16	1.22	.20	1.78			.17		--		0	2.1		S		
					26	8	57	9													
		41N/12E-15R01 M																			
08/18/82	5050	81.0F	7.8	220	11	1.0	31	8.0	91		--	6.0	--	--	--		32	2.4			
1400	5050	27.2C	7.8	217	.55	.08	1.35	.20	1.82			.17		--		0	2.4		S		
					25	4	62	9													
08/24/83	5050	81.0F	7.8	218	--	--	--	--	--		--	--	--	--	--						
1530	0000	27.2C												--							

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				SAR ASAR	REM	
			LABORATORY	PH	EC	CA	MG	NA	K	PERCENT REACTANCE VALUE			B TURB	F SIO2	TDS SUM	TH NCH			
										CACO3	SO4	CL							NO3

	A		SACRAMENTO HB																
	A-23		PITT RIVER HU																
	A-23.E		UPPER PITT RIVER HA																
	A-23.E2		ALTURAS HSA																
	41N/13E-18P01 M																		
09/10/63	5050					103	50	20	11	216	267	13	4.1	.2	--	722	464	0.4	E
1205	5050		8.0	938	5.14	4.11	.87	.28	4.32	5.56	.37	.07	--	--	598	247	1.0		
					49	40	8	3	42	54	4	1							
08/25/64	5050				--	--	24	--	230	--	14	--	--	--		529			
1220	5050		8.3	1020			1.04		4.60		.39		--	--					
							9											S	
08/12/65	5050				98	65	--	--	--	311	--	--	--	--		515			
	5050			973	4.89	5.35				6.48			--	--				S	
08/29/66	5050				116	50	--	--	225	306	--	--	--	--		498			
1430	5050		8.1	991	5.79	4.11			4.50	6.37			--	--		270		S	
08/07/67	5050	59.0F			--	--	25	--	--	--	14	--	--	--		530			
1410	5050	15.0C	8.3	1040			1.09				.39		--	--				S	
							9												
07/24/68	5050	59 F	7.1	920	103	46	24	8.7	218	252	13	3.0	.0	--	663	445	0.5	E	
1200	5050	15 C	8.3	924	5.14	3.78	1.04	.22	4.36	5.25	.37	.05	--	--	580	228	1.2		
					50	37	10	2	43	52	4	0							
07/14/69	0000	59.0F	7.0	1010	--	--	--	--	--	--	--	--	--	--					
1420	5050	15.0C											--	--					
07/27/71	5050	66 F	7.2	890	--	--	--	--	--	--	--	--	--	--					
1550	0000	19 C											--	--					
08/24/72	5050	62.0F	7.3	900	--	--	--	--	--	--	--	--	--	--					
1325	0000	16.7C											--	--					
08/02/73	5050	63.0F	7.3	750	--	--	--	--	--	--	13	--	--	--		376			
0820	5050	17.2C		773							.37		--	--				S	
07/18/74	5050	65.0F	7.3	580	70	24	17	8.5	188	116	9.1	1.6	.0	--	415	275	0.4		
0825	5050	18.3C	8.1	604	3.49	1.97	.74	.22	3.76	2.42	.26	.03	--	--	359	85	1.0		
					54	31	12	3	58	37	4	0							

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER							
				CA	MG	NA	K	PERCENT CACD3	REACTANCE SO4	VALUE CL	NO3	TURB	B SIO2	F TDS SUM	TH NCH	SAR ASAR	REM		

A A-23 A-23.E A-23.E2 41N/13E-10P01 M																			
SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																			
CONTINUED																			
08/14/75	5050	66.0F	7.3	750	74	31	18	8.0	193	138	7.9	2.9	.0	--	484	313	0.4	E	
1315	5050	18.9C	8.4	653	3.69	2.55	.78	.20	3.86	2.87	.22	.05	--	--	396	119	1.0	S	
					51	35	11	3	55	41	3	1							
08/24/76	5050	63.0F	7.2	800	--	--	--	--	--	--	--	--	--	--					
1145	0000	17.2C											--	--				S	
													--	--					
08/02/77	5050	61.0F	7.4	575	--	--	--	--	--	--	--	--	--	--				S	
1515	0000	16.1C											--	--					
08/24/78	5050	61.0F	7.2	675	82	31	19	10	196	164	8.3	2.2	.0	--	512	331	0.5	E	
1210	5050	16.1C	8.3	713	4.09	2.55	.83	.26	3.92	3.41	.23	.04	--	--	434	136	1.0		
					53	33	11	3	52	45	3	1							
07/12/79	5050	62.0F	7.1	740	--	--	--	--	--	--	--	--	--	--					
1240	0000	16.7C											--	--					
													--	--					
08/13/80	5050	62.0F	7.2	700	--	--	--	--	--	--	--	--	--	--					
1345	0000	16.7C											--	--					
08/13/81	5050	61.0F	7.3	920	109	46	23	9.0	220	272	11	2.4	.2	--	726	461	0.5	E	
1230	5050	16.1C	8.1	904	5.44	3.78	1.00	.23	4.40	5.66	.31	.04	--	--	605	241	1.1		
					52	36	10	2	42	54	3	0							
08/19/82	5050	60.0F	7.0	1000	--	--	--	--	--	--	--	--	--	--					
1240	0000	15.5C											--	--				S	
													--	--					
08/24/83	5050	62.0F	7.3	645	--	--	--	--	--	--	--	--	--	--					
1420	0000	16.7C											--	--				S	
													--	--					

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM	
* * * * *																					
A A-23 A-23.E A-23.E2 41N/13E-30L01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																			
06/02/58	5050	56.0F			49	17	16	11	208	24	6.9	--	.03	.2		193	0.5				
1540	9551	13.3C	8.3	340	2.45	1.40	.70	.28	4.16	.50	.19	--	52.0		301	0	1.1		S		
42N/10E-29A01 M																					
08/25/83	5050	185.0F	8.7	1250	21	.0	--	--	37	--	163	--	3.5	--		52					
1520	5050	84.9C	7.6	1260	1.05	.00			.74		4.60		--			16			S		
42N/11E-11R01 M																					
08/19/82	5050	64.0F	7.3	395	30	10	32	13	169	--	6.0	--	.0	--		116	1.3				
0800	5050	17.8C	8.2	386	1.50	.82	1.39	.33	3.38		.17		--			0	2.3		S		
42N/11E-13A03 M																					
08/25/83	5050	64.0F	7.3	395	--	--	--	--	--	--	--	--	--	--					S		
1415	0000	17.8C																			
42N/11E-13A03 M																					
09/02/82	5050	60.0F	7.5	530	51	16	32	13	195	--	12	--	.0	.2		193	1.0				
1325	5050	15.5C	8.2	520	2.54	1.32	1.39	.33	3.90		.34		--			0	2.1		S		
42N/11E-24A01 M																					
06/04/58	5050	58.0F			21	4.2	13	5.6	84	7.2	7.7	5.9	.0	.3		70	0.7				
1035	9551	14.4C	7.5	180	1.05	.35	.57	.14	1.68	.15	.22	.10		56.0	171	0	0.9				
42N/11E-11R01 M																					
07/29/60	5050	57.0F			19	5.2	14	5.8	84	3.0	5.8	9.4	.04	.3		69	0.7				
0721	5050	13.9C	7.9	207	.95	.43	.61	.15	1.68	.06	.16	.15		61.0	174	0	1.0				
42N/11E-13A03 M																					
08/24/61	5050	61.0F			18	5.1	13	5.3	79	3.4	5.5	9.5	.05	.3		66	0.7				
1335	5050	16.1C	8.0	197	.90	.42	.57	.14	1.58	.07	.16	.15		63.0	170	0	0.9				
42N/11E-24A01 M																					
08/28/62	5050	59.0F			17	5.9	14	5.1	84	2.4	3.5	10.0	.1	.2		146	67	0.7	F		
1015	5050	15.0C	8.0	200	.85	.49	.61	.13	1.68	.05	.10	.16		49.0	157	0	1.0				
42N/11E-11R01 M																					
09/11/63	5050				17	5.7	12	5.7	76	2.8	5.4	9.1	.2	--		139	66	0.6			
1245	5050		7.6	210	.85	.47	.52	.15	1.52	.06	.15	.15		--	103	0	0.8		T		

MINERAL ANALYSES OF GROUND WATER

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MINERAL ANALYSES OF GROUND WATER

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MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				REMARK	
			LABORATORY PH	EC	CA	MG	NA	K	PERCENT REACTANCE VALUE			TURB	F SI02	TDS SUM	TH NCH	SAR ASAR		
									CAC03	SD4	CL							NO3

	A		SACRAMENTO HB															
	A-23		PITT RIVER HU															
	A-23.E		UPPER PITT RIVER HA															
	A-23.E2		ALTURAS HSA															
08/17/82	5050		64.0F	7.5	310	30	10	16	6.5	137	--	4.0	--	--		116	0.6	
0810	5050		17.8C	7.9	306	1.50	.82	.70	.17	2.74		.11	--	--		0	1.1	
						47	26	22	5								S	
08/24/83	5050		63.0F	7.4	335	--	--	--	--	--	--	--	--	--				
0805	0000		17.2C														S	
		42N/12E-01B01 M																
08/16/82	5050		76.0F	7.5	350	--	--	--	--	--	--	--	--	--				
1455	0000		24.4C														S	
		42N/12E-01R01 M																
06/04/58	5050		59.0F			36	11	14	8.2	142	20	8.5	4.2	.0	.2	134	0.5	
1320	9551		15.0C	8.4	270	1.80	.90	.61	.21	2.84	.42	.24	.07	68.0	255	0	0.9	
						51	26	17	6	80	12	7	2				C	
		42N/12E-02A01 M																
06/04/58	5050		66.0F			36	6.5	14	9.0	139	15	5.4	2.2	.0	.2	117	0.6	
1155	9551		18.9C	8.1	250	1.80	.53	.61	.23	2.78	.31	.15	.04	68.0	239	0	1.0	
						57	17	19	7	85	9	5	1				C	
		42N/12E-02J03 M																
08/17/82	5050		63.0F	7.7	340	--	--	--	--	--	--	--	--	--				
0935	0000		17.2C															
		42N/12E-02R01 M																
08/16/82	5050		63.0F	7.8	350	39	10	16	8.9	158	--	5.0	--	.0	.3	139	0.6	
1545	5050		17.2C	8.3	348	1.95	.82	.70	.23	3.16		.14	--	--		0	1.1	
						53	22	19	6								S	
08/24/83	5050		60.0F	7.8	345	--	--	--	--	--	--	--	--	--				
0830	0000		15.5C														S	

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM
			CA	MG			NA	K	CACO3	SO4	CL	NO3	TURB	B	F							

	A A-23 A-23.E A-23.E2 42N/12E-07M01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																			
06/04/58 0955	5050 9551	57.0F 13.9C	8.2 325	42 2.10 49	14 1.15 27	17 .74 17	10 .26 6	175 3.50 81	24 .50 12	8.3 .23 5	4.3 .07 2	.0 74.0	.4		299	160 0	0.6 1.1	C				
08/19/82 0745	5050 0000	55.0F 12.8C	7.1 465	--	--	--	--	--	--	--	--	--	--	--								
08/25/83 1400	5050 5050	60.0F 15.5C	7.3 450 8.2 439	44 2.20	16 1.32	--	--	184 3.68	--	8.0 .23	--	.0 --	--	--		176 0		S				
06/04/58 0920	5050 9551	62.0F 16.7C	8.4 250	36 1.80 52	11 .90 26	13 .57 17	7.2 .18 5	156 3.12 88	12 .25 7	5.6 .16 4	1.7 .03 1	.0 70.0	.3		250	134 0	0.5 0.9	C				
08/19/82 0725	5050 5050	59.0F 15.0C	7.3 380 7.4 376	20 1.00 28	5.0 .41 12	43 1.87 53	9.4 .24 7	87 1.74	--	40 1.13	--	--	--	--		70 0	2.2 2.9	S				
06/04/58 0855	5050 9551	62.0F 16.7C	8.2 280	21 1.05 29	17 1.40 38	21 .91 25	11 .28 8	153 3.06 82	21 .44 12	7.4 .21 6	2.7 .04 1	.02 78.0	.3		271	123 0	0.8 1.5	C				
06/04/58 0835	5050 9551	56.0F 13.3C	8.3 250	29 1.45 44	5.8 .48 15	25 1.09 33	9.6 .25 8	127 2.54 75	19 .40 12	13 .38 11	3.0 .05 1	.06 66.0	.3		247	95 0	1.1 1.8	C				
08/16/82 1605	5050 0000	66.0F 18.9C	7.3 300	--	--	--	--	--	--	--	--	--	--	--								
08/24/83 0900	5050 5050	67.0F 19.4C	7.2 300 8.0 301	20 1.00	3.0 .25	--	--	121 2.42	--	9.0 .25	--	.2 --	--	--		62 0		S				

MINERAL ANALYSES OF GROUND WATER

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DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH MCH	SAR ASAR	RE4
				CA	MG	NA	K	CACO3	SD4	CL	NO3	TURB	B	F	SID2				

A A-23 A-23.E A-23.E2 42N/12E-11J01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																	
08/07/67	5050	64.5F		40	13	18	8.1	157	20	9.7	8.2	.0	--			221	159	0.6	
1230	5050	18.0C	8.3 388	2.00	1.07	.78	.21	3.14	.42	.27	.13	--	--			211	0	1.2	
				49	26	19	5	79	11	7	3								
07/24/68	0000	64 F	7.4 395	--	--	--	--	--	--	--	--	--	--						
1405	5050	18 C																	
07/17/69	5050	67.0F	7.5 380	--	--	17	--	162	--	8.0	--	--	.3				151		
1530	5050	19.4C	7.8 365			.74		3.24		.23			--						S
				20															
07/22/70	0000	64 F	7.5 380	--	--	--	--	--	--	--	--	--	--						S
1540	5050	18 C																	
07/28/71	5050	64 F	7.4 370	--	--	--	--	--	--	--	--	--	--						S
0930	0000	18 C																	
08/24/72	5050	63.0F	7.5 395	--	--	--	--	--	--	--	--	--	--						S
1430	0000	17.2C																	
07/31/73	5050	66.0F	7.4 370	--	--	--	--	--	--	8.2	9.3	--	--				149		S
1400	5050	18.9C	379							.23	.15								
07/16/74	5050	63.0F	7.4 400	44	16	18	3.5	171	17	10	13.0	.0	--			281	176	0.6	
1240	5050	17.2C	8.2 411	2.20	1.32	.78	.09	3.42	.35	.28	.21	--	--			224	5	1.2	T
				50	30	18	2	80	8	7	5								
08/12/75	5050	64.0F	7.4 392	--	--	--	--	--	--	--	--	--	--						
1130	0000	17.8C																	
08/26/76	5050	63.0F	7.5 420	--	--	--	--	--	--	--	--	--	--						
1500	0000	17.2C																	
06/29/77	5050	64.0F	7.4 400	42	10	20	6.3	162	19	9.0	8.8	.0	--			260	146	0.7	
1030	5050	17.8C	8.3 397	2.10	.82	.87	.16	3.24	.40	.25	.14	--	--			212	0	1.4	
				53	21	22	4	80	10	6	3								

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MINERAL ANALYSES OF GROUND WATER

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DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS		TH	SAR	REM
				CA	MG	NA	K	CACO3	SO4	CL	NO3	TURB	SiO2	SUM	NCH	ASAR				

	A A-23 A-23.E A-23.E2 42N/12E-11J01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																	
08/22/78 0930	5050 0000	61.0F 16.1C	7.6 395	--	--	--	--	--	--	--	--	--	--				S			
07/10/79 0955	5050 0000	63.0F 17.2C	7.3 380	--	--	--	--	--	--	--	--	--	--				S			
08/13/80 1510	5050 0000	62.0F 16.7C	7.4 400	--	--	--	--	--	--	--	--	--	--				S			
08/13/81 1200	5050 5050	65.0F 18.3C	7.5 380 372	42 2.10 53	11 .90 23	18 .78 20	7.9 .20 5	158 3.16	--	8.0 .23	--	--	--		150 0	0.6 1.2	S			
08/17/82 0900	5050 0000	64.0F 17.8C	7.4 390	--	--	--	--	--	--	--	--	--	--				S			
08/24/83 1000	5050 0000	62.0F 16.7C	7.3 415	--	--	--	--	--	--	--	--	--	--				S			
09/19/84 1345	5050 0000	66.0F 18.9C	7.8 325	--	--	--	--	--	--	--	--	--	--				S			
	42N/12E-11Q01 M																			
07/29/60 0944	5050 5050			26 1.30 28	4.9 .40 9	60 2.61 56	12 .31 7	139 2.78 62	34 .71 16	34 .96 21	2.9 .05 1	.68 79.0	.3 337		85 0	2.8 4.5				
08/23/61 0845	5050 5050	74.0F 23.3C	8.1 475	24 1.20 26	3.9 .32 7	64 2.78 60	12 .31 7	139 2.78 60	36 .75 16	38 1.07 23	2.8 .05 1	.76 80.0	.3 345		76 0	3.2 4.9				
03/21/62 1310	5050 5050		8.0 360	39 1.95 52	10 .82 22	18 .78 21	7.7 .20 5	156 3.12 84	15 .31 8	6.0 .17 5	6.8 .11 3	.06 70.0	.3 266		139 0	0.7 1.2				

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MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL	CONSTITUENTS IN				MILLIGRAMS PER LITER				MILLIGRAMS PER LITER				REMARKS	
			LABORATORY PH	EC		CA	MG	NA	K	WILLIEQUIVALENTS PER LITER				B TURB	F SIO2	TDS SUM	TH NCH		SAR ASAR
										PERCENT	REACTANCE	VALUE							

	A A-23 A-23.E A-23.E2 42N/12E-11Q01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																
08/08/62	5050				28	3.2	62	13	141	36	35	2.0	.7	.2	312	83	3.0	E	
0945	5050		7.9	445	1.40	.26	2.70	.33	2.82	.75	.99	.03		66.0	330	0	4.6		
					30	6	58	7	61	16	22	1							
09/10/63	5050				26	5.4	59	14	143	32	34	2.2	.7	--	361	87	2.8	E	
1410	5050		8.0	485	1.30	.44	2.57	.36	2.86	.67	.96	.04		--	259	0	4.4	T	
					28	9	55	8	63	15	21	1							
08/27/64	5050				--	--	59	--	144	--	35	--	--	--		86			
0850	5050		8.4	477			2.57		2.88		.99			--				S	
							60												
08/12/65	5050				--	--	58	--	--	--	--	--	.60	--		86			
	5050			446			2.52						--					S	
							59												
	42N/12E-12F01 M																		
06/03/58	5050	57.0F			37	14	16	7.6	166	17	8.5	8.3	.0	.3		149	0.6		
1435	9551	13.9C	8.4	290	1.85	1.15	.70	.19	3.32	.35	.24	.13		60.0	268	0	1.1	C	
					48	30	18	5	82	9	6	3							
	42N/12E-20N01 M																		
08/19/82	5050	67.0F	7.7	200	4.0	1.0	36	6.9	77	--	7.0	--	.0	--		14	4.2		
1035	5050	19.4C	7.8	202	.20	.08	1.57	.18	1.54		.20			--		0	2.4		
					10	4	77	9										S	
	42N/12E-23N01 M																		
08/18/82	5050	75.0F	7.1	1150	16	3.0	199	32	176	--	171	--	4.1	.7		52	12.0		
1620	5050	23.9C	8.1	1120	.80	.25	8.66	.82	3.52		4.82			--		0	16.8		
					8	2	82	8										S	
04/20/83	5050	59.0F	7.1	1325	17	3.0	234	36	185	133	209	3.1	4.5	--	911	55	13.7	E	
1030	5050	15.0C	8.0	1290	.85	.25	10.18	.92	3.70	2.77	5.89	.05		--	751	0	19.6		
					7	2	83	8	30	22	47	0							

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				RE4
			CA	MG			NA	K	PERCENT REACTANCE VALUE				B	F	TDS SUM	TH MCH	SAR ASAR		
									CACO3	SO4	CL	NO3						TURB	

	A A-23 A-23.E A-23.E2 42N/12E-24C01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																
06/03/58	5050	60.0F			33	8.9	35	12	175	25	12	--	.09	.2		119	1.4		
1325	9551	15.5C	8.1	300	1.65	.73	1.52	.31	3.50	.52	.34	--		68.0	299	0	2.5	S	
					39	17	36	7											
06/03/58	5050	58.0F			31	4.8	56	9.6	216	13	6.3	1.2	.23	.2		97	2.5		
1215	9551	14.4C	8.0	310	1.55	.39	2.44	.25	4.32	.27	.18	.02		66.0	318	0	4.5	C	
					33	8	53	5	90	6	4	0							
08/18/82	5050	89.0F	7.6	380	--	--	--	--	--	--	--	--	--	--					
1640	0000	31.6C												--					
08/18/82	5050	77.0F	7.3	305	5.0	1.0	56	10	102	--	18	--	--	--		16	6.1		
1605	5050	25.0C	7.9	306	.25	.08	2.44	.26	2.04		.51	--	--	--		0	4.5	S	
					8	3	81	9											
08/24/83	5050	76.0F	7.2	290	--	--	--	--	--	--	--	--	--	--					
1605	0000	24.4C												--					
08/18/82	5050	73.0F	7.3	1160	23	5.0	202	27	188	--	160	--	4.6	--		78	10.0		
1540	5050	22.8C	8.2	1140	1.15	.41	8.79	.69	3.76		4.51	--	--	--		0	15.9	S	
					10	4	80	6											
08/18/82	5050	68.0F	7.3	355	26	7.0	34	8.2	121	--	19	--	--	--		94	1.5		
1555	5050	20.0C	8.0	355	1.30	.58	1.48	.21	2.42		.54	--	--	--		0	2.4	S	
					36	16	41	6											
08/24/83	5050	64.0F	7.3	390	--	--	--	--	--	--	--	--	--	--					
1555	0000	17.8C												--					
09/20/84	5050	63.0F	7.3	380	--	--	--	--	--	--	--	--	--	--					
0835	0000	17.2C												--					

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	REM
			PH	EC	CA	MG	NA	K	PERCENT REACTANCE VALUE				B TURB	F SI02						
									CACO3	SD4	CL	NO3								

	A A-23 A-23.E A-23.E2 42N/12E-28G01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																	
08/19/82 1520	5050 0000	71.0F 21.6C	7.3	325	--	--	--	--	--	--	--	--	--	--						
08/25/83 1600	5050 5050	63.0F 17.2C	7.2 8.0	380 375	22 1.10	5.0 .41	--	--	129 2.58	--	22 .62	3.8 .06	.2	--		76 0				
08/19/82 1201	5050 5050	74.0F 23.3C	7.7 7.5	202 201	7.0 .35 18	1.0 .08 4	30 1.31 68	7.0 .18 9	74 1.48	--	9.0 .25	--	--	--		22 0	2.8 2.1			
08/25/83 1110	5050 0000	66.0F 18.9C	7.6	205	--	--	--	--	--	--	--	--	--	--						
08/19/82 1500	5050 5050	67.0F 19.4C	7.4 7.5	215 207	7.0 .35 16	2.0 .16 8	33 1.44 68	7.1 .18 8	73 1.46	--	11 .31	--	--	--		26 0	2.8 2.3			
08/25/83 1140	5050 0000	60.0F 15.5C	7.6	205	--	--	--	--	--	--	--	--	--	--						
07/18/86 0930	5050 5000	0 F 18 C	7.7	238	11 .55 22	17 1.40 55	7.2 .31 12	11 .28 11	124 2.48 96	1.0 .02 1	.5 .01 0	3.9 .06 2	.01	.0 51.0	177	99 0	0.3 0.5			
08/16/82 1330	5050 5050	72.0F 22.2C	7.5 7.9	320 315	16 .80 24	4.0 .33 10	43 1.87 57	11 .28 9	136 2.72	--	6.0 .17	--	.0	--		56 0	2.5 3.5			

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				REMARKS		
			LABORATORY				CA	MG	NA	K	CACO3	REACTANCE	PERCENT	CL	NO3	TURB	F SiO2	TDS SUM		TH NCH	SAR ASAR

	A A-23 A-23.E A-23.E2 42N/13E-05M01	M	SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA																		
06/04/58 1250	5050 9551	62.0F 16.7C	8.4	300	37	11	20	10	159	22	.1	6.3	.02	.1	139	0.7	C				
					1.85	.90	.07	.26	3.18	.46	.00	.10	70.0	272	0	1.4					
					48	23	22	7	85	12	0	3									
06/04/58 1220	5050 9551	64.0F 17.8C	8.2	280	39	8.2	20	10	150	21	8.7	6.5	.01	.2	132	0.8	C				
					1.95	.67	.07	.26	3.00	.44	.25	.10	58.0	261	0	1.4					
					52	18	23	7	79	12	7	3									
06/15/83 0600	5050 5050	58.0F 14.4C	7.4	450 430	47	13	22	8.3	175	24	7.0	22.0	.0	--	302	171	0.7	E			
					2.35	1.07	.96	.21	3.50	.50	.20	.35	--	248	0	1.4					
					51	23	21	5	77	11	4	8									
08/17/82 0845	5050 5050	66.0F 18.9C	7.8	320 315	27	4.0	33	9.2	134	--	6.0	--	--	--	84	1.6	S				
					1.35	.33	1.44	.24	2.68	.17	--	0	2.5								
					40	10	43	7													
09/16/82 1440	5050 5050	62.0F 16.7C	7.3	975 938	59	46	58	7.3	487	--	8.0	--	.1	--	336	1.4	S				
					2.94	3.78	2.52	.19	9.73	.23	--	0	3.7								
					31	40	27	2													
06/14/83 1200	5050 5050	53.0F 11.7C	7.4	1100 959	66	52	59	7.8	469	72	7.0	27.0	.2	--	575	379	1.3	S			
					3.29	4.28	2.57	.20	9.37	1.50	.20	.44	--	572	0	3.5					
					32	41	25	2	81	13	2	4									
06/03/58 1400	5050 9551	57.0F 13.9C	8.3	220	23	8.7	20	6.2	120	13	8.7	4.8	.03	.3	94	0.9	C				
					1.15	.72	.87	.16	2.40	.27	.25	.08	68.0	224	0	1.4					
					40	25	30	6	80	9	8	3									
08/17/82 1105	5050 5050	59.0F 15.0C	7.1	325 333	28	10	26	5.9	138	--	8.0	--	--	--	111	1.1	S				
					1.40	.82	1.13	.15	2.76	.23	--	0	1.8								
					40	23	32	4													

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				REY	
			PH	EC	CA	MG	NA	K	PERCENT CACO3	REACTANCE SO4	VALUE CL	NO3	TURB	B SIO2	F TDS SUM	TH MCH		SAR ASAR

	A		SACRAMENTO HB															
	A-23		PITT RIVER HU															
	A-23.E		UPPER PITT RIVER HA															
	A-23.E2		ALTURAS HSA															
08/17/82	5050		61.0F	7.5	330	33	12	14	4.9	133	--	9.0	--	--		132	0.5	
1135	5050		16.1C	7.9	322	1.65	.99	.61	.13	2.66		.25	--	--		0	0.9	
						49	29	18	4									
08/24/83	5050		59.0F	7.4	338	--	--	--	--	--	--	--	--	--				
1045	0000		15.0C															
	42N/13E-17L02 M																	
08/17/82	5050		63.0F	7.6	365	36	12	20	6.5	154	--	10	--	.0	--	140	0.7	
1206	5050		17.2C	8.0	364	1.80	.99	.87	.17	3.08		.28	--	--		0	1.4	
						47	26	23	4									
08/24/83	5050		61.0F	7.4	370	--	--	--	--	--	--	--	--	--				
1120	0000		16.1C															
	42N/13E-18Q01 M																	
08/18/82	5050		50.0F	7.3	295	--	--	--	--	--	--	--	--	--				
0800	0000		10.0C															
	42N/13E-19B01 M																	
08/18/82	5050		57.0F	7.7	395	--	--	--	--	--	--	--	--	--				
0745	0000		13.9C															
	42N/13E-20B02 M																	
08/17/82	5050		62.0F	7.4	290	27	8.0	19	6.6	120	--	7.0	--	--		101	0.8	
1320	5050		16.7C	7.8	292	1.35	.66	.83	.17	2.40		.20	--	--		0	1.3	
						45	22	28	6									
	42N/13E-20E01 M																	
08/17/82	5050		64.0F	7.7	300	27	8.0	22	6.7	124	--	8.0	--	--		101	1.0	
1430	5050		17.8C	8.1	300	1.35	.66	.96	.17	2.48		.23	--	--		0	1.5	
						43	21	31	5									

[illegible]

SACRAMENTO HB
PITT RIVER HU
UPPER PITT RIVER HA
ALTURAS HSA

CONTINUED

[illegible]

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY		MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				TDS SUM	TH MCH	SAR ASAR	REV		
			PH	EC	CA	MG	NA	K	PERCENT CACO3	REACTANCE SO4	VALUE CL	NO3	TURB	B	F							

	A A-23 A-23.E A-23.E2 42N/13E-31601 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				CONTINUED															
07/28/71 0855	5050 0000	61 F 16 C	7.3	570	--	--	--	--	--	--	--	--	--	--								
08/24/72 1445	5050 0000	61.0F 16.1C	7.1	600	--	--	--	--	--	--	--	--	--	--								
08/02/73 0745	5050 0000	63.0F 18.3C	7.1	560	--	--	--	--	--	--	--	--	--	--								
07/18/74 0750	5050 0000	60.0F 15.5C	7.1	550	--	--	--	--	--	--	--	--	--	--								
08/14/75 1240	5050 0000	61.0F 16.1C	7.1	580	--	--	--	--	--	--	--	--	--	--								
08/24/76 1130	5050 0000	60.0F 15.5C	7.2	565	--	--	--	--	--	--	--	--	--	--								
08/02/77 1450	5050 5050	70.0F 21.1C	7.0 8.8	580 579	20 1.00 16	6.0 .49 8	104 4.52 72	10 .26 4	303 6.05 96	6.0 .12 2	4.0 .11 2	.3 .00 0	.2	-- --	380 332	74 0	5.3 9.6					
09/22/78 1030	5050 0000	59.0F 15.0C	7.2	545	--	--	--	--	--	--	--	--	--	--								
07/10/79 1015	5050 0000	58.0F 14.4C	7.1	560	--	--	--	--	--	--	--	--	--	--				S				
08/13/80 1400	5050 0000	62.0F 16.7C	7.1	595	--	--	--	--	--	--	--	--	--	--				S				
08/13/81 1215	5050 0000	62.0F 16.7C	7.0	585	--	--	--	--	--	--	--	--	--	--				S				

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MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		MINERAL	CONSTITUENTS IN				MILLIGRAMS PER LITER				MILLIGRAMS PER LITER				SAR	REM
			PH	EC		CA	MG	NA	K	PERCENT REACTANCE VALUE		PERCENT REACTANCE VALUE		TDS	TH	ASAR			
										CACD3	SD4	CL	NO3				TURB		

	A A-23 A-23.E A-23.E2 42N/13E-31G01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA								CONTINUED								
08/19/82	5050	61.0F	7.1	575	21	7.0	98	11	296	--	3.0	--	--	--		82	4.7		
1225	5050	16.1C	8.7	546	1.05	.58	4.26	.28	5.91		.08		--	--		0	8.8		
					17	9	69	5									S		
08/24/83	5050	62.0F	7.2	555	--	--	--	--	--	--	--	--	--	--					
1340	0000	16.7C															S		
	42N/13E-31H01 M																		
08/18/82	5050	60.0F	7.2	400	32	10	42	6.5	202	--	5.0	--	--	--		121	1.7		
0940	5050	15.5C	8.2	400	1.60	.82	1.83	.17	4.04		.14		--	--		0	3.1		
					36	19	41	4									S		
	42N/13E-31P02 M																		
08/18/82	5050	80.0F	8.0	600	8.0	1.0	113	9.2	110	--	66	--	2.3	--		24	10.0		
0925	5050	26.6C	8.0	599	.40	.08	4.92	.24	2.20		1.86		--	--		0	9.1		
					7	1	87	4									S		
	42N/13E-32C02 M																		
08/18/82	5050	56.0F	7.2	500	31	16	27	8.9	276	--	1.0	--	--	--		144	1.0		
1000	5050	13.3C	8.3	485	1.55	1.32	1.17	.23	5.51		.03		--	--		0	2.1		
					36	31	27	5									S		
	42N/13E-32G01 M																		
06/03/58	5050	54.0F			33	11	24	6.0	180	5.6	3.7	--	.01	.3		128	0.9		
1130	9551	12.2C	8.1	255	1.65	.90	1.04	.15	3.60	.12	.10			52.0	243	0	1.7		
					44	24	28	4									S		
08/25/59	5050	62.0F			19	6.7	105	12	312	6.6	4.1	.2	.3	.3	421	75	5.3		
	5050	16.7C	8.2	576	.95	.55	4.57	.31	6.23	.14	.12	.00		80.0	421	0	9.7		
					15	9	72	5	96	2	2	0					E		
08/27/59	5050	56.0F			32	11	29	6.5	187	4.8	3.9	.2	.0	.2	255	125	1.1		
	5050	13.3C	8.0	364	1.60	.90	1.26	.17	3.74	.10	.11	.00		55.0	255	0	2.1		
					41	23	32	4	95	3	3	0					E		
07/29/60	5050	59.0F			33	11	29	5.5	184	5.6	3.7	.4	.03	.3		127	1.1		
0730	5050	15.0C	8.2	354	1.65	.90	1.26	.14	3.68	.12	.10	.01		57.0	256	0	2.1		
					42	23	32	4	94	3	3	0							
08/24/61	5050	55.0F			33	10	24	5.7	179	4.3	3.0	.5	.05	.2		124	0.9		
0920	5050	12.8C	8.4	353	1.65	.82	1.04	.15	3.58	.09	.08	.01		57.0	245	0	1.7		
					45	22	28	4	95	2	2	0							

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				SAR	REN
				CA	MG	NA	K	CACO3	SO4	CL	NO3	TURB	SiO2	TDS SUM	TH MCH	ASAR	

		SACRAMENTO HB															
		PITT RIVER HU															
		UPPER PITT RIVER HA															
		ALTURAS HSA															
		CONTINUED															
08/28/62	5050			34	8.5	31	5.6	179	4.8	3.6	.0	.1	.2	228	71	1.6	
0915	5050		8.4 340	1.70	.70	1.35	.14	3.58	.10	.10	.00		53.0	248	0	2.6	
				44	18	35	4	95	3	3	0						
09/10/63	5050			32	11	27	6.7	180	4.4	3.0	.4	.1	--	249	124	1.1	
1240	5050		8.1 367	1.60	.90	1.17	.17	3.60	.09	.08	.01		--	193	0	2.0	T
				42	23	30	4	95	2	2	0						
08/25/64	5050			--	--	28	--	183	--	3.4	--	--	--		126		
1310	5050		8.4 368			1.22		3.66		.10			--				S
						33											
09/12/65	5050			--	--	29	--	--	--	--	--	--	--		123		
5050			342			1.26							--				S
						34											
08/29/66	0000			--	--	--	--	--	--	--	--	--	--				
5050			345										--				
08/02/67	5050			--	--	29	--	--	--	3.7	--	--	--		124		
1330	5050		8.5 371			1.26				.10			--				S
						34											
07/24/68	0000	54 F	7.5 370	--	--	--	--	--	--	--	--	--	--				
1220	5050	12 C											--				
07/14/69	5050	57.0F	7.4 378	33	9.8	29	6.3	179	5.8	3.6	.6	.0	--	224	123	1.1	
1310	5050	13.9C	8.0 342	1.65	.81	1.26	.16	3.58	.12	.10	.01		--	195	0	2.1	
				43	21	32	4	94	3	3	0						
07/22/70	0000	60 F	7.5 360	--	--	--	--	--	--	--	--	--	--				
1035	5050	16 C											--				S
07/28/71	5050	63 F	7.4 355	--	--	--	--	--	--	--	--	--	--				
0900	0000	17 C											--				S
08/24/72	5050	59.0F	7.1 375	--	--	--	--	--	--	--	--	--	--				
1455	0000	15.0C											--				S

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				REMARKS	
			LABORATORY	LABORATORY			CA	MG	NA	K	PERCENT REACTANCE VALUE				TURB	SiO2	TDS SUM	TH MCH		SAR ASAR
											CAC03	SO4	CL	NO3						

	A		SACRAMENTO HB																	
	A-23		PITT RIVER HU																	
	A-23.E		UPPER PITT RIVER HA																	
	A-23.E2		ALTURAS HSA																	
	42N/13E-32601 M																			
08/03/73	5050	69.0F	7.3	375	--	--	--	--	--		4.8	--	--	--			126			
0755	5050	20.5C		366							.14		--	--					S	
07/18/74	5050	62.0F	7.6	350	--	--	--	--	--		--	--	--	--					S	
0800	0000	16.7C																		
08/14/75	5050	58.0F	7.4	360	--	--	--	--	--		--	--	--	--					S	
1255	0000	14.4C																		
08/24/76	5050	62.0F	7.5	360	--	--	--	--	--		--	--	--	--					S	
1120	0000	16.7C																		
08/02/77	5050	59.0F	7.4	375	32	11	29	4.8	181	4.0	3.0	.7	.0	281	125	1.1	E			
1500	5050	15.0C	8.8	369	1.60	.90	1.26	.12	3.62	.08	.08	.01		193	0	2.1	T			
				41	23	32	3	96		2	2	0								
08/22/78	5050	58.0F	7.5	355	--	--	--	--	--		--	--	--	--					S	
1045	0000	14.4C																		
07/10/79	5050	62.0F	7.5	360	--	--	--	--	--		--	--	--	--					S	
1030	0000	16.7C																		
08/13/80	5050	59.0F	7.3	375	--	--	--	--	--		--	--	--	--					S	
1415	0000	15.0C																		
08/13/81	5050	70.0F	7.6	365	--	--	--	--	--		--	--	--	--					S	
1205	0000	21.1C																		
08/19/82	5050	68.0F	7.5	360	33	11	28	6.0	178	--	4.0	--	--	--		128	1.1			
1215	5050	20.0C	8.6	352	1.65	.90	1.22	.15	3.56		.11		--	--		0	2.0		S	
				42	23	31	4													
08/24/83	5050	64.0F	7.3	370	--	--	--	--	--		--	--	--	--						
1400	0000	17.8C																		

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD		PH	EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER PERCENT REACTANCE VALUE				MILLIGRAMS PER LITER				TDS SUM	TH NCH	SAR ASAR	RE4
			CA	MG			NA	K	CACO3	SO4	CL	NO3	TURB	B	F							
																SI02						

	A A-23 A-23.E A-23.E2 42N/13E-33J01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS MSA																			
08/18/82	5050	59.0F	7.3	80	7.0	2.0	4.0	2.2	37	--	.0	--	--	--		26	0.3	S				
1020	5050	15.0C	7.1	76	.35	.16	.17	.06	.74		.00		--	--		0	0.2					
					47	22	23	8														
06/05/58	5050	56.0F			20	11	14	6.6	126	1.5	4.5	--	.0	.2		95	0.6	S				
0940	9551	13.3C	8.3	210	1.00	.90	.61	.17	2.52	.03	.13			57.0	191	0	1.0					
					37	34	23	6														
08/16/82	5050	69.0F	7.0	135	10	3.0	11	3.8	50	--	3.0	--	--	--		38	0.8	S				
1415	5050	20.5C	7.2	136	.50	.25	.48	.10	1.00		.08		--	--		0	0.7					
					38	19	36	8														
08/17/82	5050	71.0F	7.8	300	--	--	--	--	--	--	--	--	--	--				E				
0750	0000	21.6C											--	--								
07/29/58	5050	56.0F			28	7.8	10	2.1	105	1.6	3.7	15.0	.1	.2	188	102	0.4	E				
	5050	13.3C	8.0	248	1.40	.64	.44	.05	2.10	.03	.10	.24		57.0	188	0	0.7					
					55	25	17	2	85	1	4	10										
07/29/58	5050	60.0F			15	1.3	23	2.3	83	5.6	3.7	2.0	.1	.2	131	43	1.5	S				
	5050	15.5C	8.0	189	.75	.11	1.00	.06	1.66	.12	.10	.03		29.0	132	0	1.7					
					39	6	52	3	87	6	5	2										
07/29/60	5050				13	2.3	23	2.0	82	6.2	4.7	1.4	.06	.1		42	1.5	S				
0720	5050		8.0	184	.65	.19	1.00	.05	1.64	.13	.13	.02		30.0	132	0	1.7					
					34	10	53	3	85	7	7	1										
08/24/61	5050	64.0F			13	2.6	22	1.8	82	4.1	1.0	9.2	.14	.3		43	1.5	S				
0705	5050	17.8C	8.0	184	.65	.21	.96	.05	1.64	.09	.03	.15		31.0	134	0	1.6					
					35	11	51	3	86	5	2	8										
08/29/62	5050				16	1.6	25	1.7	87	1.0	3.5	1.0	.1	.1	114	46	1.6	S				
0815	5050		8.0	197	.80	.13	1.09	.04	1.74	.02	.10	.02		28.0	130	0	1.8					
					39	6	53	2	93	1	5	1										

MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				REMARKS		
				CA	MG	NA	K	PERCENT REACTANCE VALUE				TURB	F SID2	TDS SUM	TH MCH		SAR ASAR	
								CACO3	SO4	CL	NO3							

A A-23 A-23.E A-23.E2 44N/13E-36A01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				CONTINUED												
09/11/63 0635	5050 5050		7.9 175	11 .55 29	2.8 .23 12	25 1.09 57	1.9 .05 3	84 1.68 89	3.8 .08 4	3.5 .10 5	1.9 .03 2	.1 21.0	.1	120 121	39 0	1.7 1.9	E	
08/ /64	5050 5050		8.3 185	--	--	24 1.04 55	--	81 1.62	--	3.6 .10	--	--	--		42		S	
08/12/65	5050 5050		185	--	--	25 1.09 57	--	--	--	--	--	--	--		41		S	
08/08/67 0800	5050 5050	60.0F 15.5C	8.2 190	--	--	25 1.09 56	--	82 1.64	--	4.0 .11	--	--	--		42		S	
07/24/68 1440	0000 5050	65.0F 18.3C	8.3 200	--	--	--	--	--	--	--	--	--	--					
07/15/69 0750	5050 5050	66.0F 18.9C	8.3 190 191	--	--	23 1.00 54	--	--	--	--	--	--	--		42		S	
07/20/70 1115	0000 5050	69 F 21 C	8.3 190	--	--	--	--	--	--	--	--	--	--					
07/27/71 0740	5050 0000	67 F 19 C	8.1 190	--	--	--	--	--	--	--	--	--	--					
08/25/72 0725	5050 0000	60.0F 15.5C	7.9 200	--	--	--	--	--	--	--	--	--	--					
07/31/73 1440	5050 5050	64.0F 17.8C	8.3 210 202	--	--	--	--	--	--	3.3 .09	--	--	--		51		S	
07/16/74 1305	5050 0000	60.0F 15.5C	8.3 200	--	--	--	--	--	--	--	--	--	--					

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MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER				TDS	TH	SAR	RE4

				CA	MG	NA	K	PERCENT REACTANCE VALUE				B	F	TDS	TH	SAR	RE4		
								CACO3	SO4	CL	NO3	TURB	SiO2	SUM	NCH	ASAR			
A																			
A-23																			
A-23.E																			
A-23.E2																			
44N/13E-36A01 M																			
SACRAMENTO HB																			
PITT RIVER HU																			
UPPER PITT RIVER HA																			
ALTURAS HSA																			
CONTINUED																			
06/29/77	5050		63.0F	7.1	180	18	6.0	6.0	2.8	82	.0	.5	.4	.0	--	127	70	0.3	E
1210	5050		17.2C	8.1	168	.90	.49	.26	.07	1.64	.00	.01	.01	--	--	83	0	0.4	T
						52	28	15	4	99	0	1	1						
08/22/78	5050		58.0F	7.4	180	--	--	--	--	--	--	--	--	--	--				
1120	0000		14.4C																
S																			
07/10/79	5050		58.0F	7.7	130	14	4.0	6.0	--	65	--	.0	--	--	--	52	0.4		
1110	5050		14.4C	8.1	132	.70	.33	.26		1.30		.00		--	--	0	0.4		
						54	26	20											
S																			
08/12/80	5050		63.0F	8.3	205	--	--	--	--	--	--	--	--	--	--				
1120	0000		17.2C																
44N/13E-36801 M																			
07/29/58	5050		62.0F			24	7.5	22	3.2	103	16	12	2.6	.1	.3	209	91	1.0	E
	5050		16.7C	8.0	287	1.20	.62	.96	.08	2.10	.33	.34	.04	58.0		208	0	1.5	
						42	22	34	3	75	12	12	1						
44N/14E-07K01 M																			
07/29/60	5050		56.0F			67	26	29	1.3	210	16	30	87.0	.03	.2		274	0.8	
0745	5050		13.3C	8.4	634	3.34	2.14	1.26	.03	4.20	.33	.85	1.40	58.0		440	64	1.7	
						49	32	19	0	62	5	13	21						
08/29/62	5050					45	18	24	1.3	195	7.6	10	26.0	.06	.2	288	188	0.8	
1145	5050			8.4	446	2.25	1.48	1.04	.03	3.90	.16	.28	.42	50.0		299	0	1.6	
						47	31	22	1	82	3	6	9						
09/11/63	5050					39	16	23	1.3	181	5.8	6.0	17.0	.1	.1	272	163	0.8	E
0645	5050			8.4	380	1.95	1.32	1.00	.03	3.62	.12	.17	.27	40.0		257	0	1.5	
						45	31	23	1	87	3	4	6						
08/26/64	5050					41	18	22	1.7	184	11	9.1	22.0	.0	--	290	177	0.7	
0735	5050			7.8	433	2.05	1.48	.96	.04	3.68	.23	.26	.35	--	--	235	0	1.4	
						45	33	21	1	81	5	6	8						
08/12/65	5050					--	--	39	--	--	--	--	--	--	--		267		
	5050				822			1.70							--				
								24											
S																			

MINERAL ANALYSES OF GROUND WATER

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MINERAL ANALYSES OF GROUND WATER

DATE TIME	SAMPLER LAB	TEMP	FIELD LABORATORY PH EC	MINERAL CONSTITUENTS IN				MILLIGRAMS PER LITER MILLIEQUIVALENTS PER LITER				MILLIGRAMS PER LITER								REM
				CA	MG	NA	K	PERCENT CACO3	REACTANCE SO4	VALUE CL	NO3	TURB	B SIO2	F	TDS SUM	TH NCH	SAR ASAR			

	A A-23 A-23.E A-23.E2 44N/14E-07K01 M		SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER MA ALTURAS HSA																	
06/29/77	5050	56.0F	6.8	705	--	--	--	--												
1225	0000	13.3C																		
																		S		
07/10/79	5050	59.0F	7.1	630	60	24	--	--	246	--	16	--	.1	--		248				
1120	5050	15.0C	8.6	588	2.99	1.97			4.92		.45					2				
																		S		
08/12/80	5050	60.0F	7.0	625	--	--	--	--												
1135	0000	15.5C																S		
09/11/81	5050	62.0F	6.9	380	--	--	--	--												
1055	0000	16.7C																S		
09/17/82	5050	61.0F	7.0	400	--	--	--	--												
1030	0000	16.1C																S		
08/24/83	5050	59 F	7.1	700	73	29	--	--	292		19	48.0	--	--		301				
1305	5050	15 C	7.8	690	3.64	2.38			5.83		.54	.77				10				
																		S		
	44N/14E-07K02 M																			
08/24/81	5050	57.0F			41	14	18	1.2	176	4.0	5.8	1.9	.09	.1		161	0.6			
0730	5050	13.9C	7.9	386	2.05	1.15	.78	.03	3.52	.08	.16	.03		29.0	221	0	1.2	S		
					51	29	19	1	93	2	4	1								

APPENDIX D
MINOR ELEMENT ANALYSIS OF GROUND WATER

CONSTITUENTS IN MILLIGRAMS PER LITER

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MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	CONSTITUENTS BARIUM CADMIUM	IN MILLIGRAMS PER LITER CHROM (ALL) CHROM (HEX)	COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM
* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *
	A A-23 A-23.E A-23.E1 41N/11E-01F01 M					SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA CANBY HSA			CONTINUED			
08/07/67 1650	5050			80.5F	0.01 D	--	--	--	--	--	--	
	41N/11E-02G01 M											
08/04/58 1040	5050 5050			62 F	--	--	--	0.00 T	--	--	--	
	41N/11E-02J01 M											
08/04/58 1010	5050 5050			64.0F	--	--	--	0.04 T	--	--	--	
07/29/60 0915	5050 5050				0.00 T	--	0.00 T	0.00 T	0.00 T	--	0.03 T	
07/29/60 0930	5050 5050				--	--	--	0.00 D	--	--	--	
09/11/63 1300	5050 5050				0.00 D	--	--	0.00 D	0.00 D	--	0.52 D	
08/31/66 1250	5050 5050		235		0.00 D	--	--	0.01 D	0.00 D	--	0.10 D	
08/24/72 1550	5050		225	64.0F 7.4	0.00 D	0.00 D	--	0.01 D 0.08 D	0.01 D 0.00 D	-- 0.00 D	0.15 D	
	41N/11E-05L01 M											
08/04/58 1150	5050 5050			57.0F	--	--	--	0.03 T	--	--	--	
	41N/11E-21P01 M											
08/04/58 1510	5050 5050			78.0F	0.00 T	--	0.00 T	0.03 T	0.00 T	--	0.00 T	
08/04/58 1525	5050 5050			78.0F	--	--	--	0.00 D	--	--	--	

MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	BARIUM CADMIUM	CHROM (ALL) CHROM (HEX)	COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM
<p>A A-23 A-23.E A-23.E1 41N/11E-26802 M</p>												
SACRAMENTO HB					CONTINUED							
PITT RIVER HU												
UPPER PITT RIVER HA												
CANBY HSA												
08/04/58 1710	5050 5050			62.0F	--	--	--	0.03 T	--	--	--	
41N/11E-29H01 M												
08/04/58 1540	5050 5050			65.0F	--	--	--	0.00 T	--	--	--	
41N/11E-29J01 M												
08/04/58 1620	5050 5050			57.0F	--	--	--	0.03 T	--	--	--	
42N/09E-23K01 M												
08/05/58 1420	5050 5050			60.0F	--	--	--	0.03 T	--	--	--	
42N/09E-26J01 M												
08/05/58 1340	5050 5050			56.0F	--	--	--	0.04 T	--	--	--	
42N/09E-35R01 M												
08/05/58 1240	5050 5050			60.0F	--	--	--	0.04 T	--	--	--	
42N/09E-36L01 M												
08/05/58 1300	5050 5050			55.0F	--	--	--	0.03 T	--	--	--	
42N/10E-13G01 M												
08/05/58 0930	5050 5050			82.0F	0.00 T	--	0.00 T	0.00 T	0.00 T	--	0.00 T	
08/05/58 0945	5050 5050			82.0F	--	--	--	0.00 T	--	--	--	

CONSTITUENTS IN MILLIGRAMS PER LITER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	CONSTITUENTS BARIUM CADMIUM	IN MILLIGRAMS CHROM (ALL) CHROM (HEX)	PER LITER COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM
	A					SACRAMENTO HB						
	A-23					PITT RIVER HU						
	A-23.E					UPPER PITT RIVER HA						
	A-23.E1					CANBY HSA						
	42N/10E-22601 M								CONTINUED			
08/05/58	5050			59.0F		--	--	--		--	--	
1010	5050				--	--	--	0.00 T	--	--	--	
	42N/10E-27E01 M											
08/05/58	5050			63.0F		--	--	--		--	--	
1040	5050				--	--	--	0.00 T	--	--	--	
	42N/10E-29H01 M											
08/05/58	5050			84.0F		--	0.00 T	0.00 T	0.00 T	--	--	
1100	5050				0.01 T	--	--	0.03 T	0.00 T	--	0.00 T	
08/05/58	5050			84.0F		--	--	--	--	--	--	
1115	5050				--	--	--	0.00 D	--	--	--	
07/29/60	5050					--	--	--	--	--	--	
0817	5050				--	--	--	0.17 T	--	--	--	
07/29/60	5050					--	--	0.02 D	0.00 D	--	--	
0818	5050				0.01 D	--	0.00 D	0.00 D	0.00 D	--	0.02 D	
09/11/63	5050					--	--	0.00 D	0.00 D	--	--	
1330	5050				0.02 D	--	--	0.01 T	0.00 D	--	0.00 D	
08/24/82	5050			88.0F		--	--	--	--	--	--	
1235	5050		262	8.4	0.01 T	--	--	--	--	--	--	
	42N/10E-31J01 M											
08/05/58	5050			57.0F		--	--	--		--	--	
1500	5050				--	--	--	0.03 T	--	--	--	
	42N/11E-09K01 M											
08/04/58	5050			50.0F		--	--	--		--	--	
0810	5050				--	--	--	0.04 T	--	--	--	
07/29/60	5050			93.0F		--	--	--		--	--	
0747	5050				--	--	--	0.00 D	--	--	--	
07/29/60	5050			93.0F		--	--	0.00 D	0.00 D	--	--	
0748	5050				0.00 D	--	0.00 D	0.28 T	0.00 D	--	0.00 D	

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MINDR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	BARIUM CADMIUM	CHROM (ALL) CHROM (HEX)	COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM		
A A-23 A-23.E A-23.E1 42N/11E-09K01 M													CONTINUED	
07/29/60 0758	5050 5050			93.0F	--	--	--	-- 0.00 D	-- --	-- --	-- --	-- --		
42N/11E-19E01 M														
08/04/58 1350	5050 5050			59 F	--	--	--	-- 0.04 T	-- --	-- --	-- --	-- --		
07/29/60 0803	5050 5050				--	--	--	-- 0.05 T	-- --	-- --	-- --	-- --		
07/29/60 0804	5050 5050				0.00 D	--	0.00 D	0.00 D 0.00 D	0.00 D 0.03 D	-- --	0.01 D	D		
09/11/63 1350	5050 5050				0.00 D	--	--	0.00 D 0.02 T	0.00 D 0.01 D	-- --	0.00 D	D		
42N/11E-22M01 M														
08/05/58 0840	5050 5050			62 F	--	--	--	-- 0.00 T	-- --	-- --	-- --	-- --		
42N/11E-25P01 M														
08/04/58 0900	5050 5050			56 F	--	--	--	-- 0.04 T	-- --	-- --	-- --	-- --		
42N/11E-33F01 M														
08/04/58 1120	5050 5050			62 F	--	--	--	-- 0.00 T	-- --	-- --	-- --	-- --		
42N/11E-35J01 M														
08/04/58 0940	5050 5050			66 F	--	--	--	-- 0.00 T	-- --	-- --	-- --	-- --		

MINOR ELEMENT ANALYSES OF GROUND WATER

DATE	SAMP	DISCH	TEMP	ARSENIC	CONSTITUENTS IN MILLIGRAMS PER LITER	LEAD	MERCURY	SILVER	REM
TIME	LAB	DEPTH	PH		BARIUM CHROM (ALL) CHROM (HEX) COPPER IRON	MANGANESE	SELENIUM	ZINC	
* * *	* * *	* * *	* * *	* * *	* * * * *	* * *	* * *	* * *	* * *
A A-23 A-23.E A-23.E2 39N/12E-02L01 M					SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA				
					CONTINUED				
06/02/58	5050		64.0F	--	--	--	--	--	
1040	5000			--	--	0.02 T	--	--	
39N/13E-05D02 M									
06/02/58	5050		59.0F	--	--	--	--	--	
1435	9551			--	--	0.00 T	--	--	
39N/13E-06N01 M									
06/02/58	5050		70.0F	--	--	--	--	--	
1300	9551			--	--	0.00 T	--	--	
07/29/60	5050		69.0F	--	--	--	--	--	
0850	5050			--	--	0.11 T	--	--	
07/29/60	5050		69.0F	0.00 D	--	0.00 D	0.01 D	--	
0851	5050			0.00 D	0.00 D	0.00 D	0.00 D	0.69 D	
09/12/63	5050			0.00 D	--	0.00 D	0.00 D	--	
0920	5050			0.00 D	--	0.04 T	0.00 D	0.14 D	
39N/13E-07N01 M									
06/02/58	5050		54.0F	--	--	--	--	--	
0950	5000			--	--	0.00 T	--	--	
39N/13E-08K01 M									
06/02/58	5050		59.0F	--	--	--	--	--	
1235	5000			--	--	0.00 T	--	--	
39N/13E-09D01 M									
06/02/58	5050		56.0F	--	--	--	--	--	
1350	5000			--	--	0.00 T	--	--	

MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	BARIUM CADMIUM	CHROM (ALL) CHROM (HEX)	COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM
* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *
A A-23 A-23.E A-23.E2 39N/13E-18A01 M					SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA					CONTINUED		
06/02/58 0915	5050 5000			58.0F	--	--	--	0.00 T	--	--	--	
40N/12E-11F01 M												
06/03/58 0845	5050 5000			66.0F	--	--	--	0.00 T	--	--	--	
07/29/60 0930	5050 5050			69.0F	--	--	--	0.19 T	--	--	--	
07/29/60 0931	5050 5050			69.0F	0.00 D	--	0.00 D	0.00 D 0.00 D	0.00 D 0.00 D	--	0.00 D	
127 09/12/63 0845	5050 5050				0.00 D	--	--	0.00 D 0.01 T	0.00 D 0.00 D	--	0.00 D	
40N/12E-25J01 M												
06/03/58 0745	5050 9551			58.0F	--	--	--	0.00 T	--	--	--	
07/29/60 0915	5050 5050			69.0F	--	--	--	0.00 T	--	--	--	
07/29/60 0915	5050 5050			69.0F	0.00 T	--	0.00 T	0.00 T 0.00 T	0.00 T 0.00 T	--	0.08 T	
07/29/60 0916	5050 5050			69.0F	0.00 D	--	0.00 D	0.00 D 0.00 D	0.00 D 0.00 D	--	0.08 D	
07/29/60 0930	5050 5050			69.0F	--	--	--	0.00 D	--	--	--	
09/12/63 0900	5050 5050				0.00 D	--	--	0.00 D 0.03 T	0.00 D 0.00 D	--	0.14 D	
08/07/67 1500	5050				0.00 D	--	--	--	--	--	--	

MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	CONSTITUENTS BARIUM CADMIUM	IN MILLIGRAMS CHROM (ALL) CHROM (HEX)	PER LITER COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM
* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *
	A A-23 A-23.E A-23.E2 40N/12E-26A01 M					SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA						
									CONTINUED			
06/03/58 0805	5050 5000			56.0F	--	--	--	0.00 T	--	--	--	
		40N/13E-31E01 M										
06/02/58 1515	5050 5000			110.0F	0.00 T	--	0.00 T	0.00 T	0.00 T	--	0.00 T	
06/02/58 1530	5050 5000			110.0F	--	--	--	0.00 D	--	--	--	
		41N/12E-02N01 M										
06/03/58 0940	5050 5000			57.0F	--	--	--	0.03 T	--	--	--	
		41N/12E-15H01 M										
06/03/58 0910	5050 5000			64.0F	--	--	--	0.00 T	--	--	--	
07/29/60 1000	5050 5050			74.0F	--	--	--	0.00 T	--	--	--	
07/29/60 1001	5050 5050			74.0F	0.00 D	--	0.00 D	0.00 D	0.00 D	--	0.09 D	
07/29/60 1015	5050 5000			74.0F	--	--	--	0.00 T	--	--	--	
09/12/63 0830	5050 5050				0.01 D	--	--	0.00 D 0.12 T	0.00 D 0.00 D	--	0.71 D	
08/07/67 1430	5050			71.5F	0.00 D	--	--	--	--	--	--	
		41N/12E-15Q01 M										
08/18/82 1405	5050 5050		215	77.0F 7.7	0.00 T	--	--	--	--	--	--	

MINOR ELEMENT ANALYSES OF GROUND WATER

DATE		SAMP	DISCH	TEMP	CONSTITUENTS		IN MILLIGRAMS		PER LITER		LEAD		MERCURY		SILVER		ZINC		REM	
TIME		LAB	DEPTH	EC	PH	ARSENIC	BARIUM	CADMIUM	CHROM (ALL)	CHROM (HEX)	COPPER	IRON	MANGANESE	SELENIUM	ZINC	ZINC	ZINC	ZINC	ZINC	ZINC
</																				

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CONSTITUENTS IN MILLIGRAMS PER LITER

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MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	BARIUM CADMIUM	CHROM (ALL) CHROM (HEX)	COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM
<p>A A-23 A-23.E A-23.E2 42N/12E-10E01 M</p>												
<p>SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA</p>					CONTINUED							
06/04/58 0835	5050 5000			56.0F	--	--	--	0.01 T	--	--	--	
42N/12E-11J01 M												
08/07/67 1230	5050			64.5F	0.01 D	--	--	--	--	--	--	
07/24/68 1405	5050 5050		395	64.0F 7.4	0.01 D	--	--	0.00 D 0.00 T	0.00 D 0.00 D	--	0.00 D	
07/17/69 1530	5050		380	67.0F 6.7	0.00 D	--	--	--	--	--	--	
42N/12E-11Q01 M												
07/29/60 0944	5050 5050				--	--	--	0.12 T	--	--	--	
07/29/60 0945	5050 5050				0.01 D	--	0.00 D	0.00 D 0.02 D	0.00 D 0.00 D	--	0.00 D	
09/10/63 1410	5050 5050				0.02 D	--	--	0.00 D 0.00 T	0.02 D 0.00 D	--	0.01 D	
42N/12E-12F01 M												
06/03/58 1435	5050 5000			57.0F	--	--	--	0.03 T	--	--	--	
42N/12E-24C01 M												
06/03/58 1325	5050 5000			60.0F	--	--	--	0.02 T	--	--	--	
42N/12E-25H01 M												
06/03/58 1215	5050 5000			58.0F	--	--	--	0.00 T	--	--	--	

MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ARSENIC	CONSTITUENTS IN MILLIGRAMS PER LITER BARIUM CADMIUM	CHROM (ALL) CHROM (HEX)	COPPER IRON	LEAD MANGANESE	MERCURY SELENIUM	SILVER ZINC	REM
* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *	* * *
	A					SACRAMENTO HB						
	A-23					PITT RIVER HU						
	A-23.E					UPPER PITT RIVER HA						
	A-23.E2					ALTURAS HSA						
	42N/13E-05M01	M							CONTINUED			
06/04/58 1250	5050 5000			62.0F	--	--	--	0.00 T	--	--	--	
	42N/13E-06601	M										
06/04/58 1220	5050 5000			64.0F	--	--	--	0.00 T	--	--	--	
	42N/13E-17D01	M										
06/03/58 1400	5050 5000			57.0F	--	--	--	0.00 T	--	--	--	
	42N/13E-22D01	M										
06/04/58 1910	5050 5000			58.0F	--	--	--	0.00 T	--	--	--	
	42N/13E-28K01	M										
06/05/58 0735	5050 5000			59.0F	--	--	--	0.01 T	--	--	--	
	42N/13E-30C01	M										
06/03/58 1250	5050 5000			65.0F	--	--	--	0.00 T	--	--	--	
	42N/13E-31G01	M										
06/03/58 1110	5050 5000			59.0F	--	--	--	0.19 T	--	--	--	
08/22/59 1610	5050 5050			62.0F	--	--	--	--	--	--	--	
07/29/60 0715	5050 5050			63.0F	--	--	--	0.29 T	--	--	--	
07/29/60 0716	5050 5050			63.0F	0.00 D	--	0.00 D	0.00 D 0.11 D	0.01 D 0.00 D	--	0.18 D	
09/10/63 1230	5050 5050				0.00 D	--	--	0.00 D 0.10 T	0.00 D 0.00 D	--	0.09 D	

MINOR ELEMENT ANALYSES OF GROUND WATER

DATE			SAMP		DISCH	TEMP	CONSTITUENTS										IN MILLIGRAMS PER LITER		LEAD		MERCURY		SILVER		REM	
TIME			LAB	DEPTH			EC	PH	ARSENIC		BARIUM		CADMIUM		CHROM (ALL)		CHROM (HEX)		COPPER		IRON		MANGANESE			SELENIUM

CONSTITUENTS IN MILLIGRAMS PER LITER

CONTINUED

SUPPLEMENTAL MINOR ELEMENT ANALYSES OF GROUND WATER

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SUPPLEMENTAL MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ALUMINUM	ANTIMONY BERYLLIUM	BISMUTH COBALT	GALLIUM GERMANIUM	LITHIUM MOLYBDENUM	NICKEL STRONTIUM	TITANIUM VANADIUM	REM
	A											
	A-23											
	A-23.E											
	A-23.E1											
	42N/11E-19E01 M											
07/29/60	5050											
0804	5050				0.0	D	--	--	--	--	--	
09/11/63	5050											
1350	5050				0.06	D	--	--	--	--	--	
	A-23.E2											
	39N/13E-06N01 M											
07/29/60	5050			69.0F								
0851	5050				0.01	D	--	--	--	--	--	
09/12/63	5050											
0920	5050				0.19	D	--	--	--	--	--	
	40N/12E-11F01 M											
07/29/60	5050			69.0F								
0931	5050				0.00	D	--	--	--	--	--	
09/12/63	5050											
0845	5050				0.07	D	--	--	--	--	--	
	40N/12E-25J01 M											
07/29/60	5050			69.0F								
0915	5050				0.0	T	--	--	--	--	--	
07/29/60	5050			69.0F								
0916	5050				0.0	D	--	--	--	--	--	
09/12/63	5050											
0900	5050				0.01	D	--	--	--	--	--	
	40N/13E-31E01 M											
06/02/58	5050			110.0F								
1515	5000				0.08	T	--	--	--	--	--	

CONTINUED

SUPPLEMENTAL MINOR ELEMENT ANALYSES OF GROUND WATER

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SUPPLEMENTAL MINOR ELEMENT ANALYSES OF GROUND WATER

DATE TIME	SAMP LAB	DEPTH	DISCH EC	TEMP PH	ALUMINUM	ANTIMONY BERYLLIUM	BISMUTH COBALT	GALLIUM GERMANIUM	LITHIUM MOLYBDENUM	NICKEL STRONTIUM	TITANIUM VANADIUM	REM
<div style="display: flex; justify-content: space-between;"> <div> A A-23 A-23.E A-23.E2 42N/13E-31601 M </div> <div> SACRAMENTO HB PITT RIVER HU UPPER PITT RIVER HA ALTURAS HSA </div> <div> CONTINUED </div> </div>												
07/29/60 0716	5050 5050			63.0F	0.0 D	--	--	--	--	--	--	
09/10/63 1230	5050 5050				0.08 D	--	--	--	--	--	--	
42N/13E-32601 M												
07/29/60 0731	5050 5050			59.0F	0.0 D	--	--	--	--	--	--	
09/10/63 1240	5050 5050				0.28 D	--	--	--	--	--	--	
44N/13E-36A01 M												
07/29/60 0721	5050 5050				0.0 D	--	--	--	--	--	--	
44N/14E-07K01 M												
07/29/60 0746	5050 5050			56.0F	0.02 D	--	--	--	--	--	--	
08/29/62 1145	5050 5050				0.00 D	--	--	--	--	--	--	